

A diagram of a DNA double helix. The two strands are represented by thick black lines that spiral around each other. Between the strands, there are horizontal lines representing base pairs, each with a small circle at its center. Two vertical dimension lines are shown: one labeled '3.4 Å' indicating the distance between two adjacent base pairs, and another labeled '10 Å' indicating the distance between two full turns of the helix.

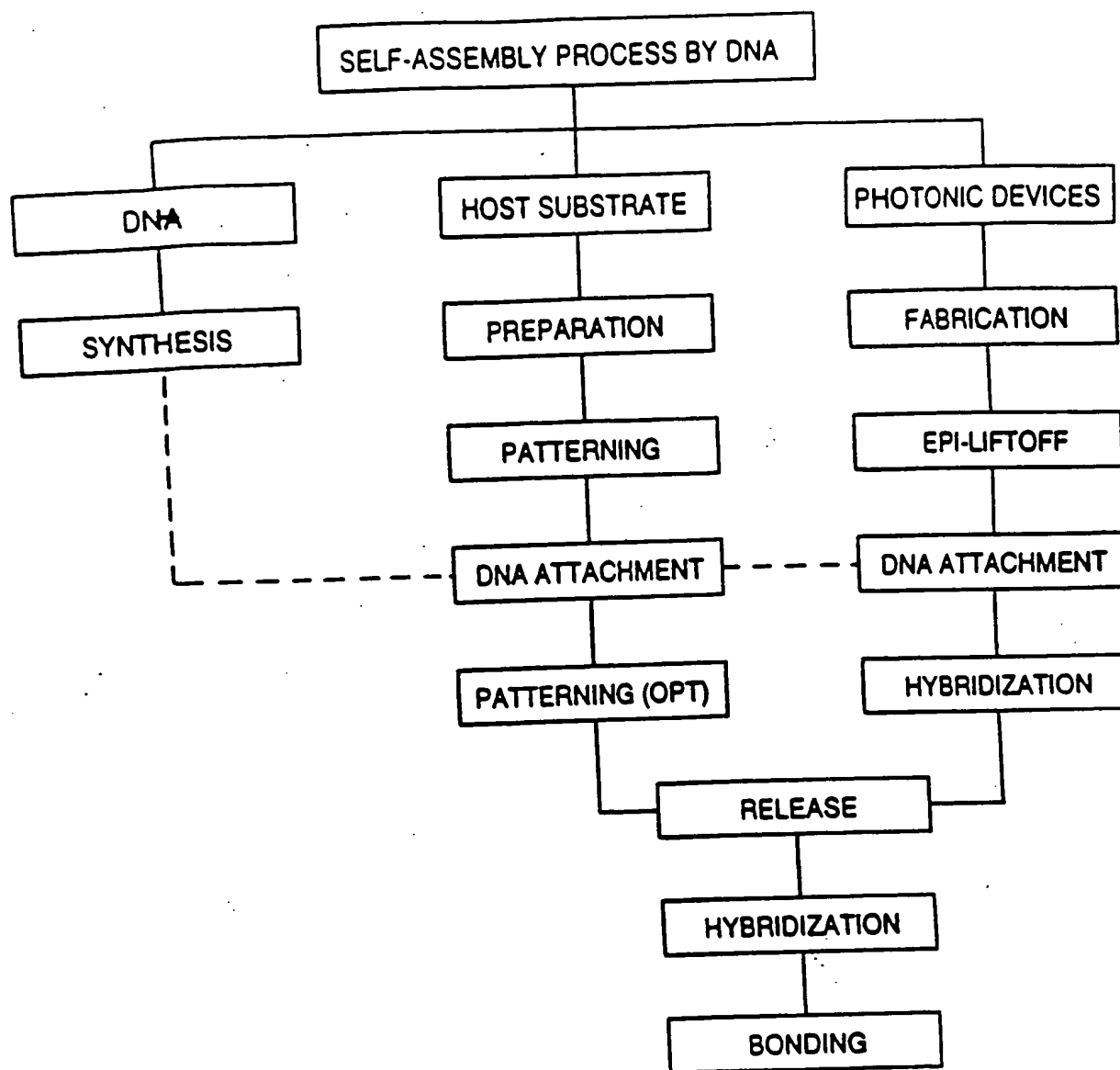


FIG. 2.

FIG. 3B.

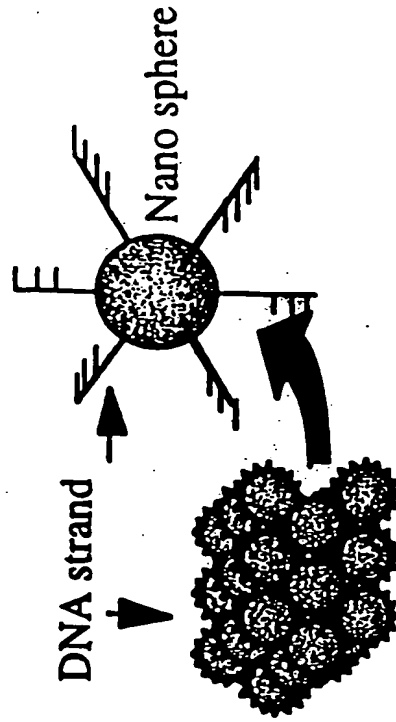
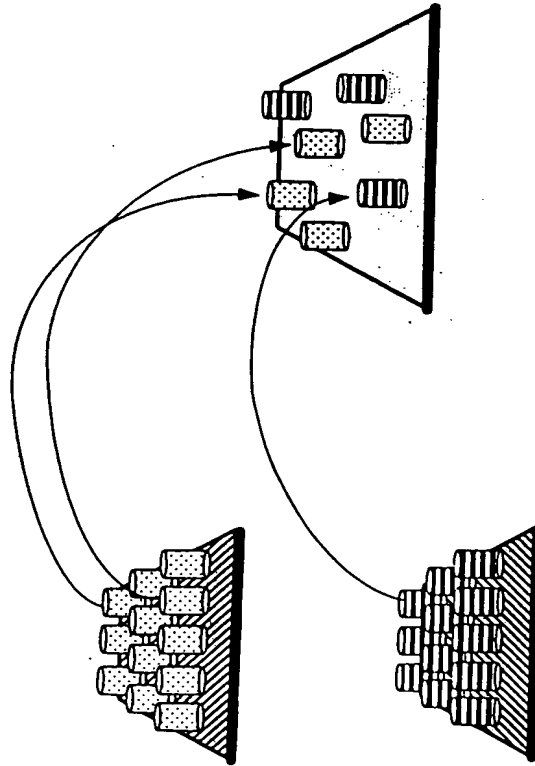
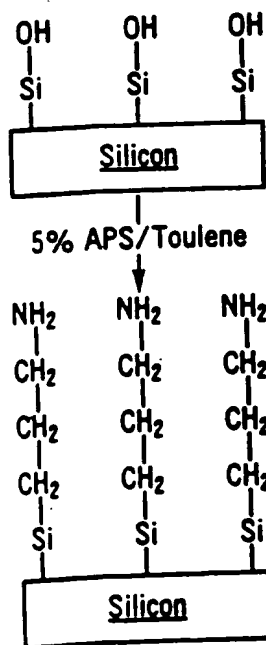


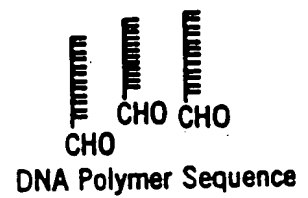
FIG. 3A.



1 Solid surface activation
by primary amine groups



2 DNA Activation to an
intermediate form that
is aldehyde terminated



3 Covalent bond formation between
the carbonyl compounds and the
amines by dehydration

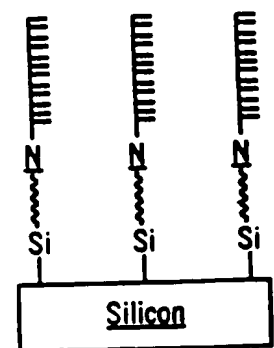
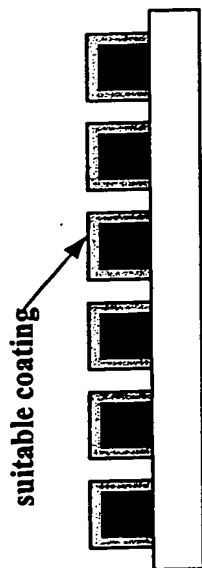


FIG. 4.

1. Standard micro/nano device fab. with sacrificial layer for liftoff

2. Suitable coating of device surface for quasi-Brownian motion capability



3. Support with polyimide or black wax



4. Epi-liftoff



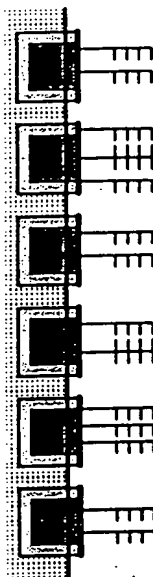
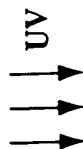
5. Polyimide recess



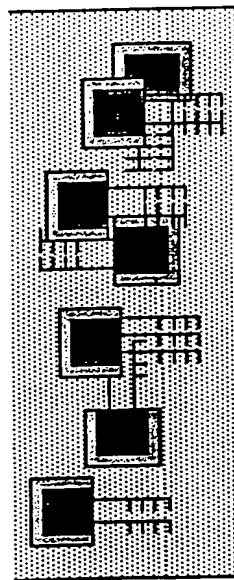
6. Metalization



7. DNA Attachment



8. Release



Hybridization with complement

Fig. 5

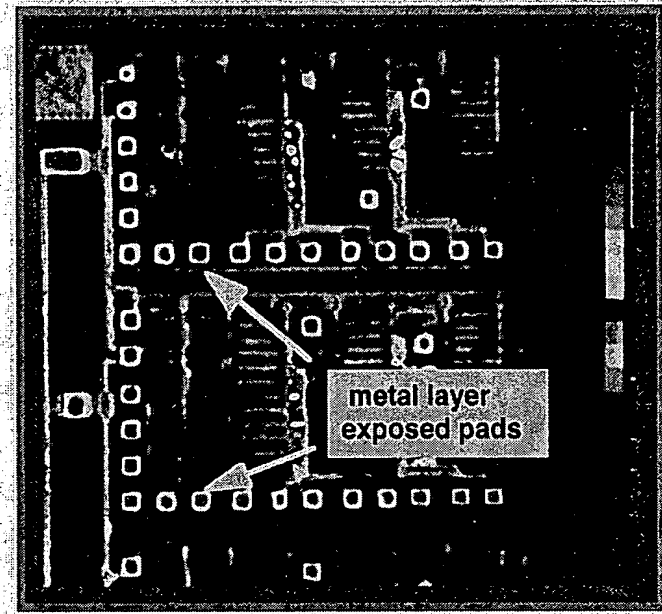


Fig. 6

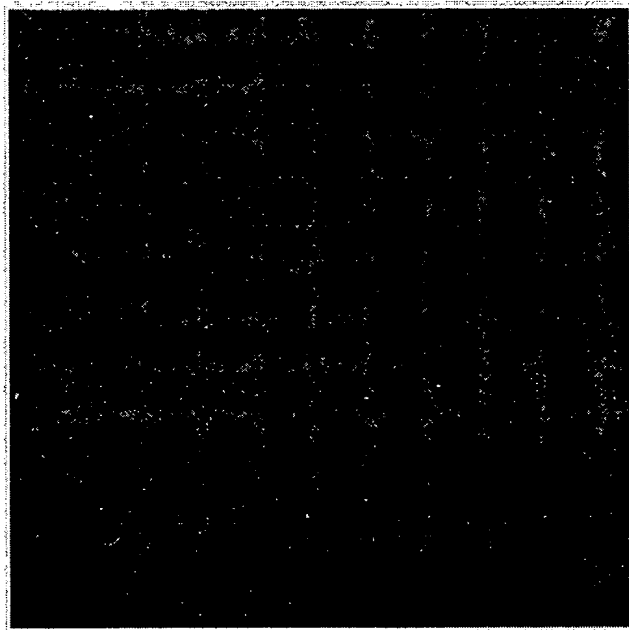


Fig. 7

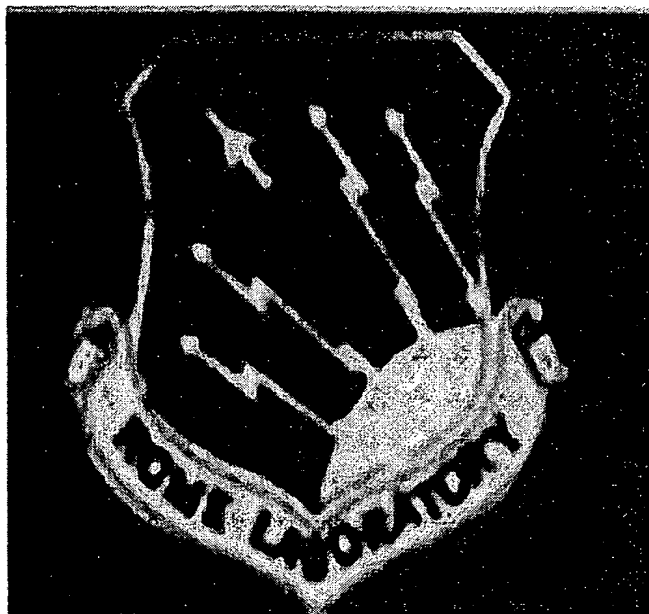


Fig. 8A

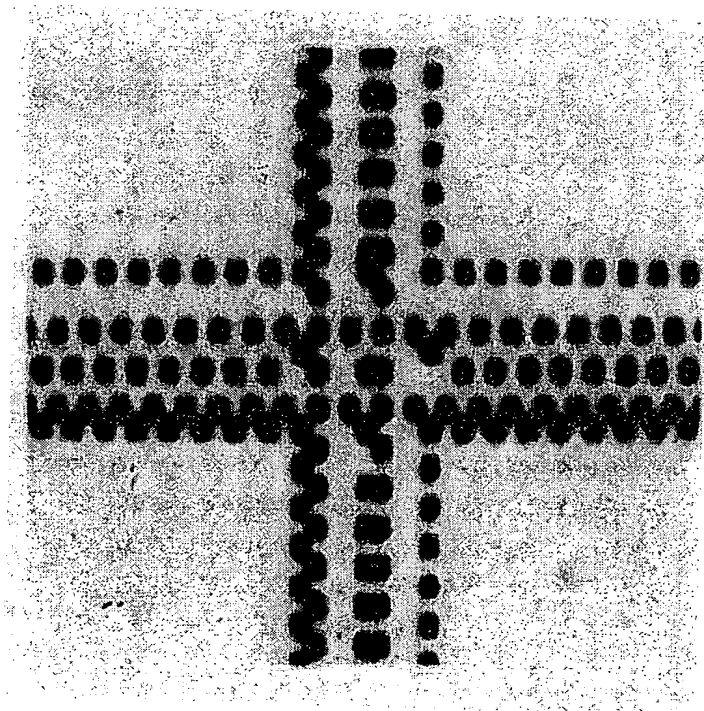


Fig. 8B

FIG. 9

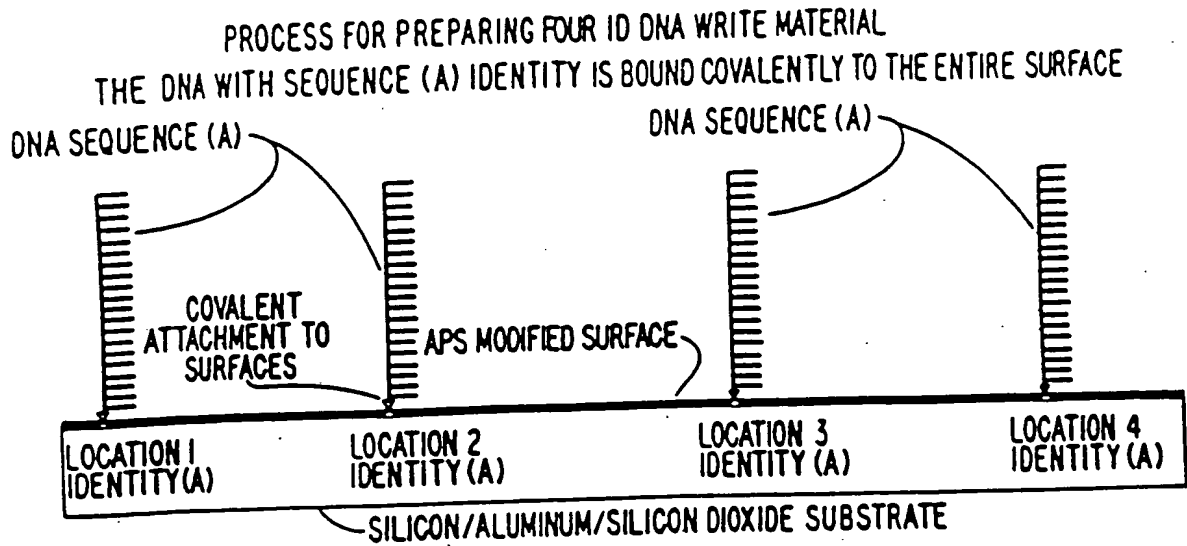


FIG. 10

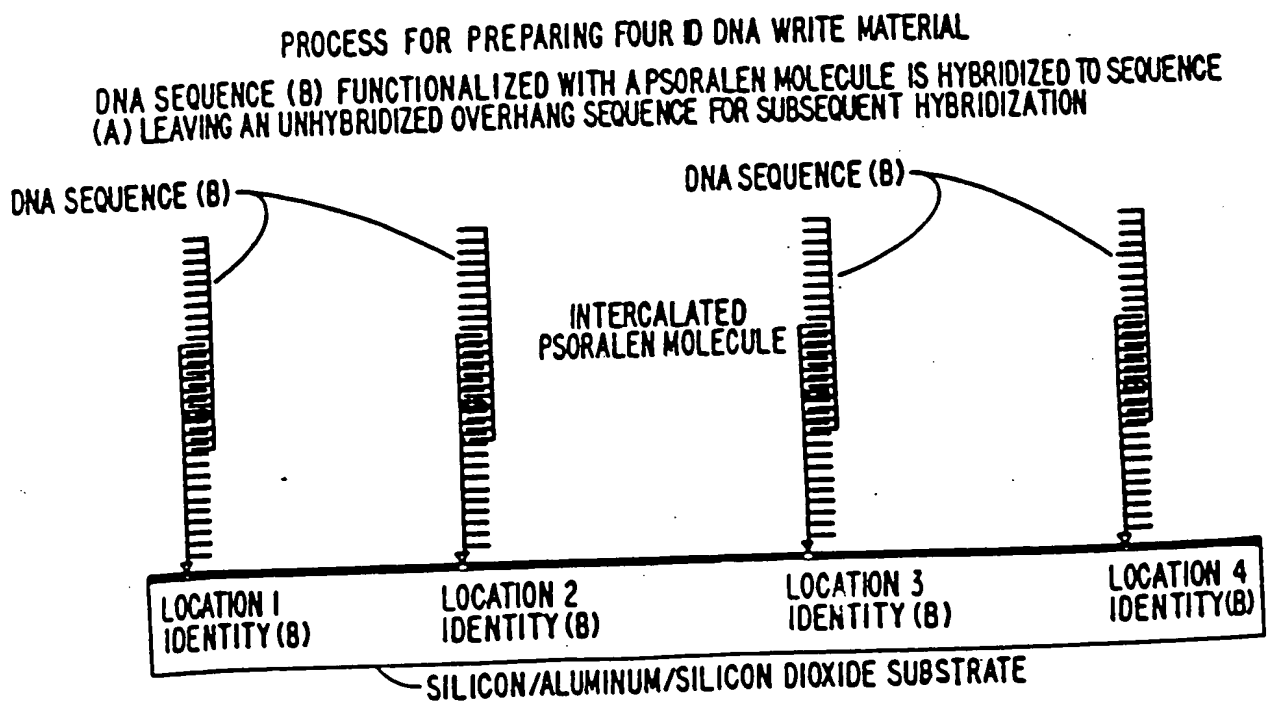


FIG. 11

LOCATION #1 IS MASKED FROM UV EXPOSURE WHILE LOCATIONS 2,3 & 4 ARE EXPOSED
ALLOWING THE PSORALEN MOLECULES TO COVALENTLY CROSS-LINK THE (A) AND (B)
DNA SEQUENCE.

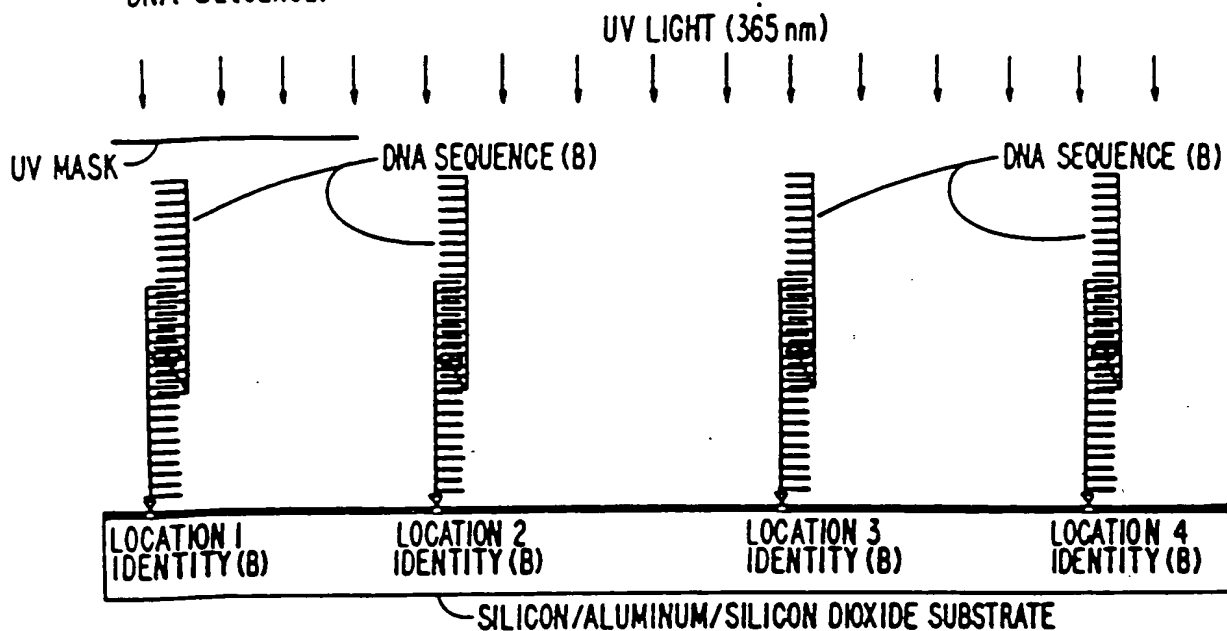


FIG. 12

PROCESS FOR PREPARING FOUR ID DNA WRITE MATERIAL

DEHYBRIDIZATION IS CARRIED OUT TO REMOVE THE NON-CROSSLINKED SEQUENCE (B) FROM THE
1st LOCATION, WHICH NOW HAS A PERMANENT (A) SEQUENCE IDENTITY. DNA SEQUENCE (B) IS
NOW COVALENTLY COUPLED TO LOCATIONS 2, 3 AND 4

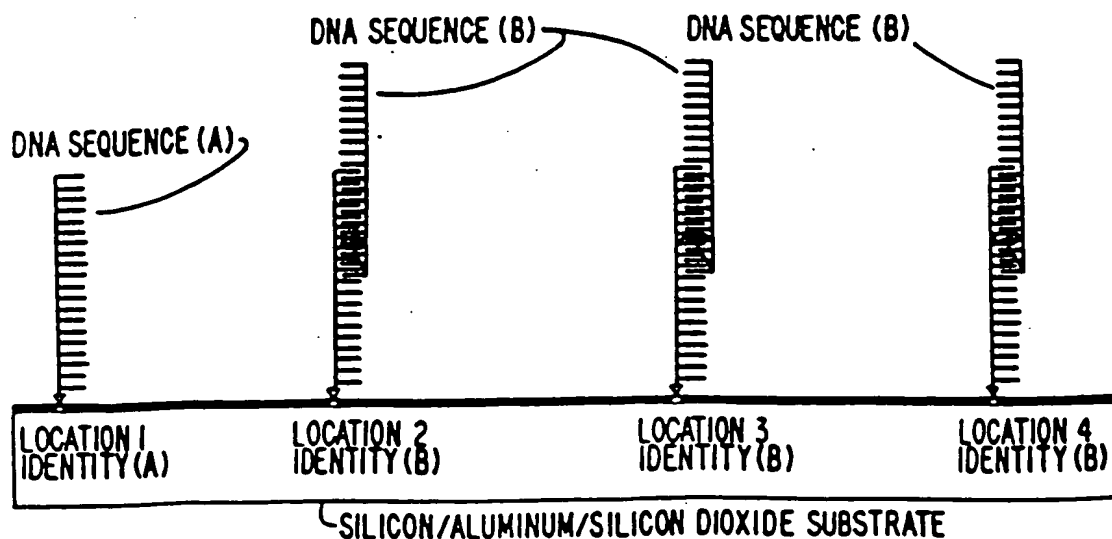


FIG. 13.

PROCESS FOR PREPARING FOUR ID DNA WRITE MATERIAL
A PSORALEN FUNCTIONALIZED DNA SEQUENCE (C) IS NOW HYBRIDIZED TO SEQUENCE (B),
AND THE PROCESS IS REPEATED.

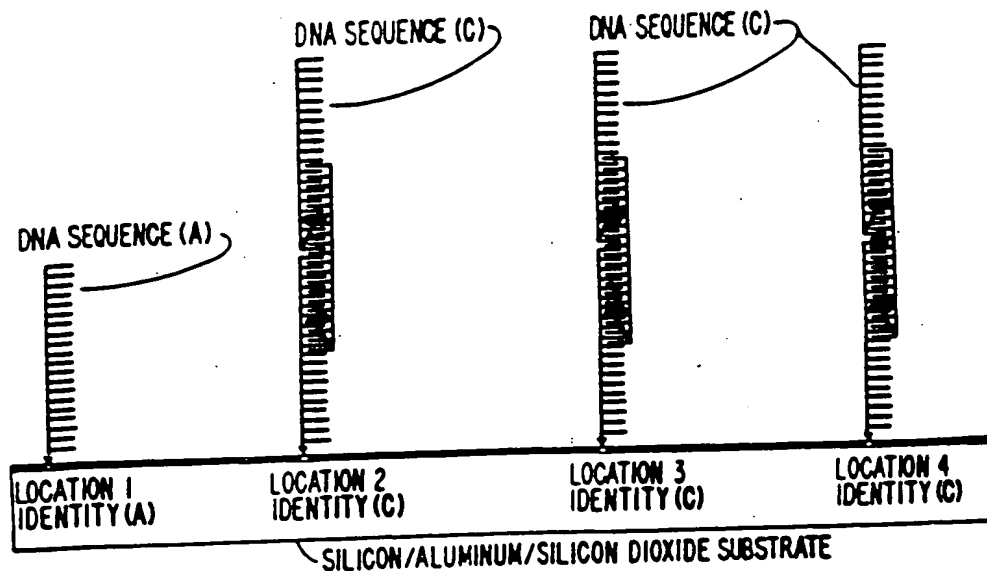


FIG. 14.

PROCESS FOR PREPARING FOUR ID DNA WRITE MATERIAL
LOCATIONS 1 AND 2 ARE NOW MASKED WHILE LOCATIONS 3 AND 4 ARE EXPOSED AFFECTING
THE COVALENT CROSS-LINKING OF SEQUENCES (B) AND (C).

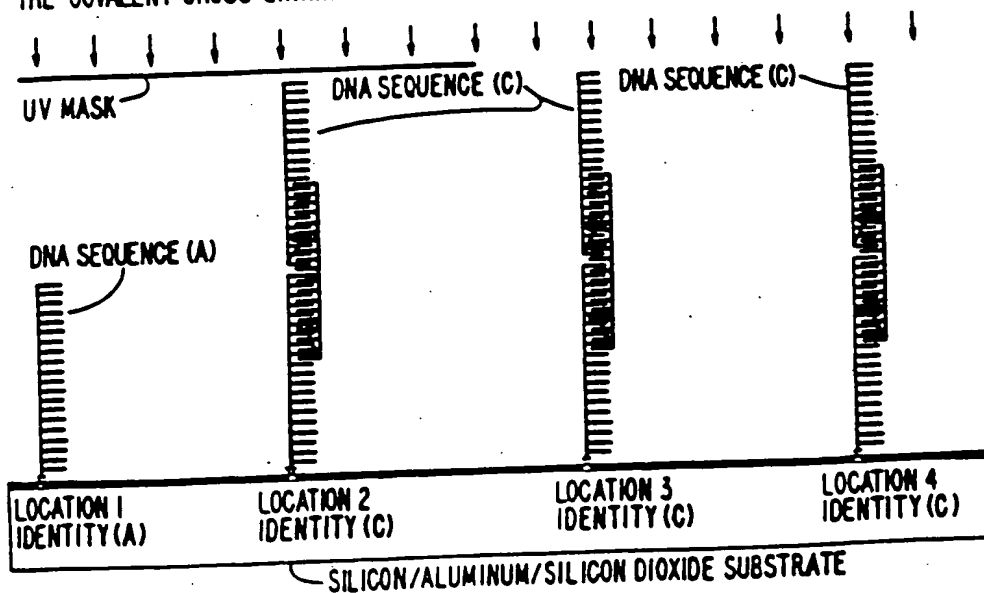


FIG. 15

PROCESS FOR PREPARING FOUR ID DNA WRITE MATERIAL

DEHYBRIDIZATION IS CARRIED OUT TO REMOVE SEQUENCE (C) FROM LOCATION 2.
A PERMANENT (B) DNA SEQUENCE IDENTITY IS NOW PRESENT AT LOCATION 2

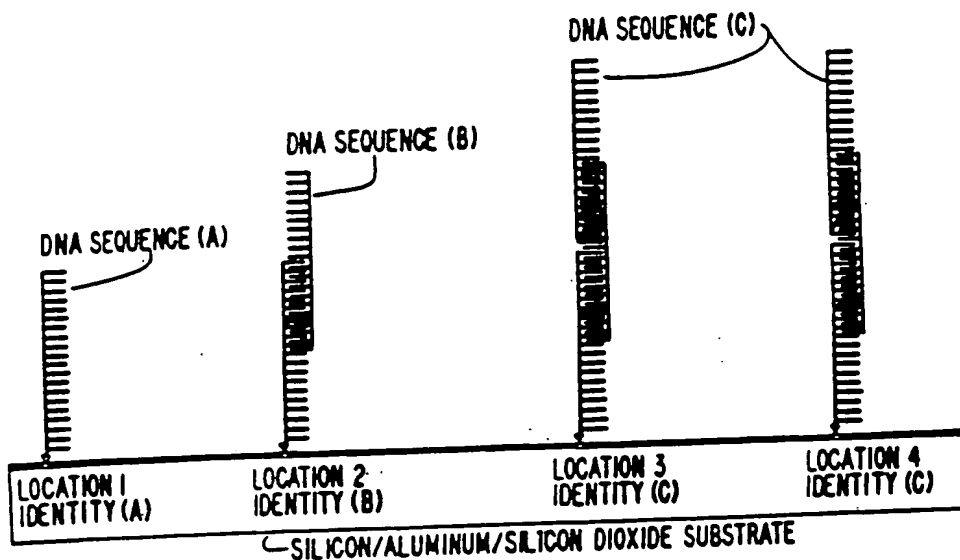


FIG. 16

PROCESS FOR PREPARING FOUR ID DNA WRITE MATERIAL

A PSORALEN FUNCTIONALIZED DNA SEQUENCE (D)
IS NOW HYBRIDIZED TO SEQUENCE (C), AND THE
PROCESS IS REPEATED.

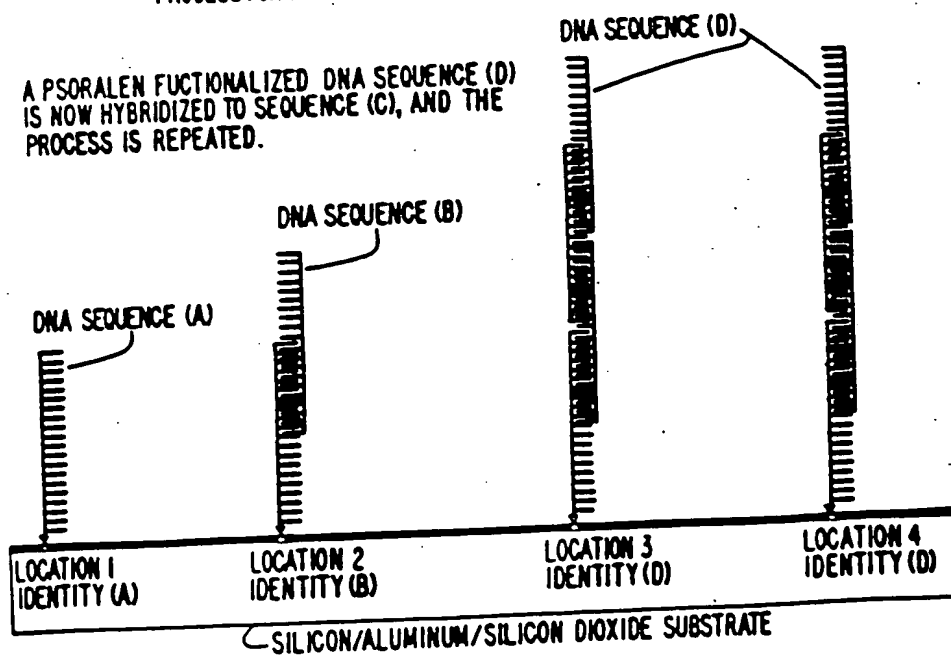


FIG. 17

PROCESS FOR PREPARING FOUR ID DNA WRITE MATERIAL

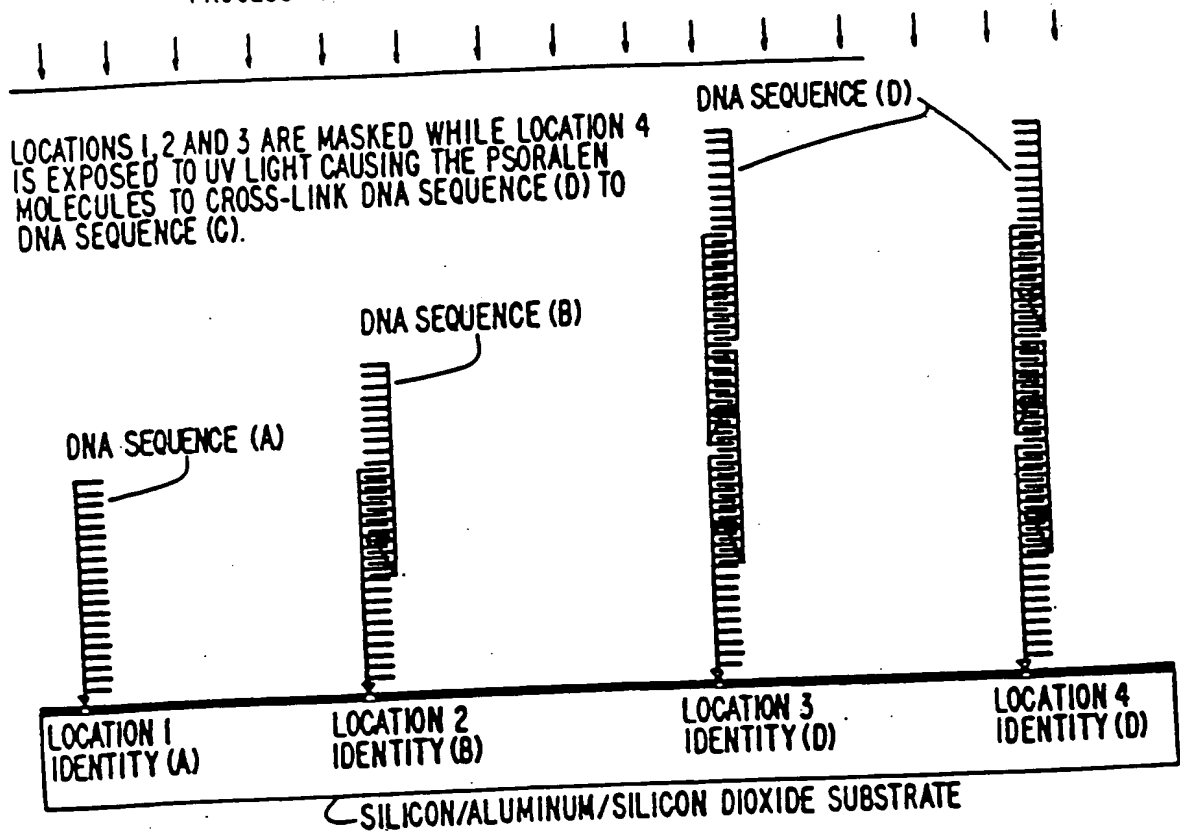


FIG. 18

PROCESS FOR PREPARING FOUR ID DNA WRITE MATERIAL

DEHYBRIDIZATION IS CARRIED OUT TO REMOVE DNA SEQUENCE (D) FROM LOCATION 3. A PERMANENT (C) IDENTITY IS PRESENT AT LOCATION 3 AND A PERMANENT (D) IDENTITY IS PRESENT AT LOCATION 4. THIS COMPLETES THE PROCESS FOR PREPARING A FOUR ID DNA WRITE MATERIAL.

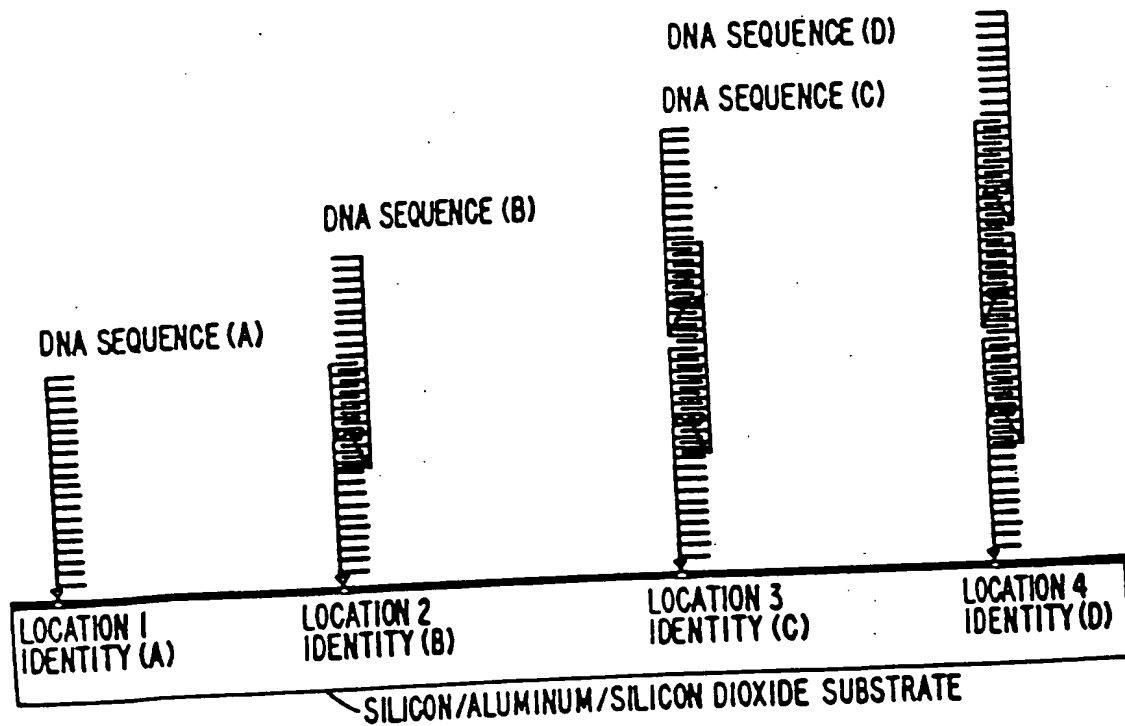


FIG. 19

PROCESS FOR PREPARING FOUR ID DNA WRITE MATERIAL

COMPLEMENTARY DNA SEQUENCES TO (A), (B), (C), (D)
IDENTITIES LABELED WITH FOUR RESPECTIVE FLUORESCENT
DYES CAN BE HYBRIDIZED TO DEMONSTRATE EACH IDENTITY

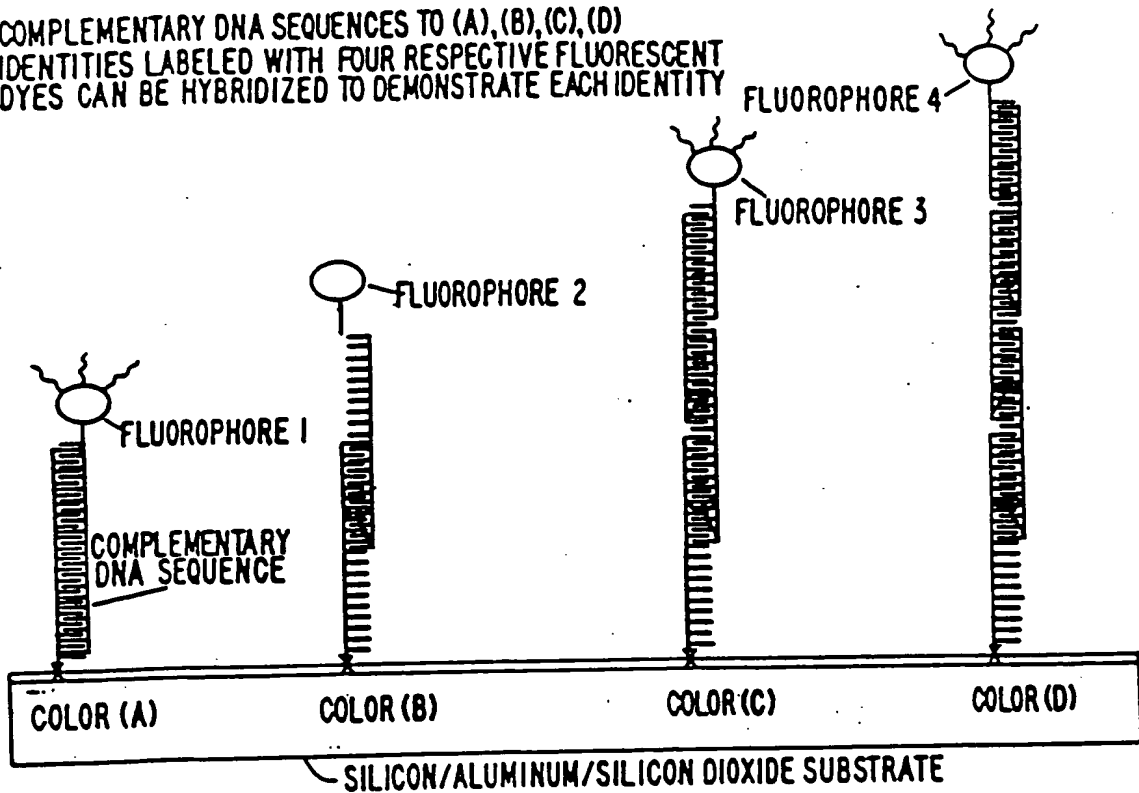


FIG. 20

PROCESS FOR WRITING TO FOUR ID DNA WRITE MATERIAL

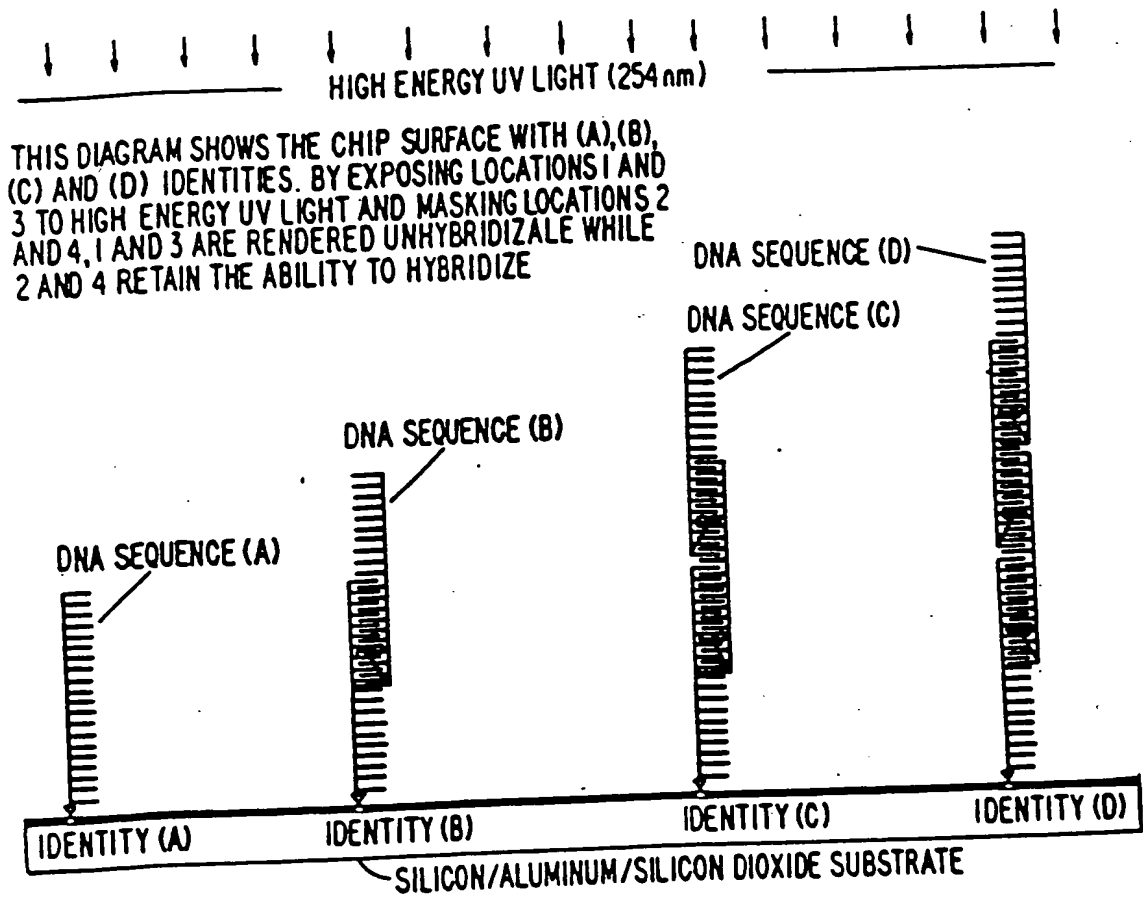


FIG. 21

PROCESS FOR WRITING TO FOUR ID DNA WRITE MATERIAL
SELECTIVE UV EXPOSURE LEAVES LOCATIONS 1 AND 3 UNHYBRIDIZABLE
AND LOCATIONS 2 AND 4 RETAIN THE ABILITY TO HYBRIDIZE

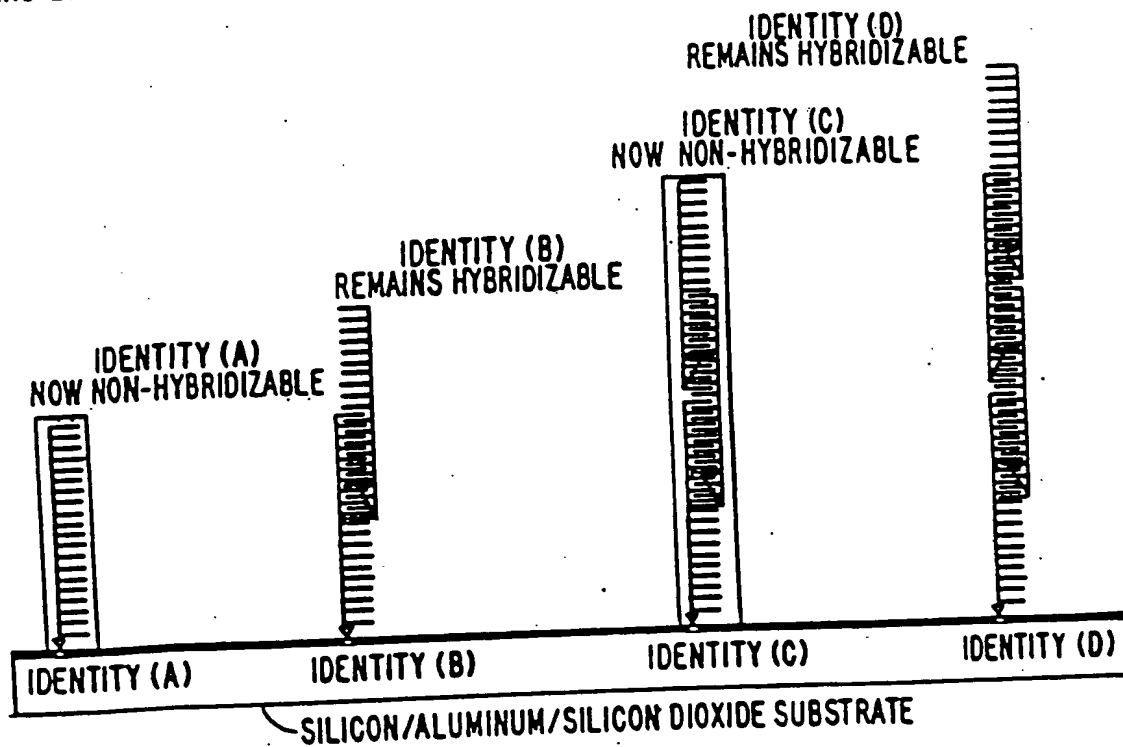


FIG. 22.

PROCESS FOR WRITING TO FOUR ID DNA WRITE MATERIAL

ALL 4 DNA COMPLEMENTS LABELED WITH THEIR RESPECTIVE FLUOROPHORES ARE
APPLIED TO THE SURFACE, ONLY LOCATIONS (B) AND (D) HYBRIDIZE THEIR
RESPECTIVE FLUORESCENT COMPLEMENTS

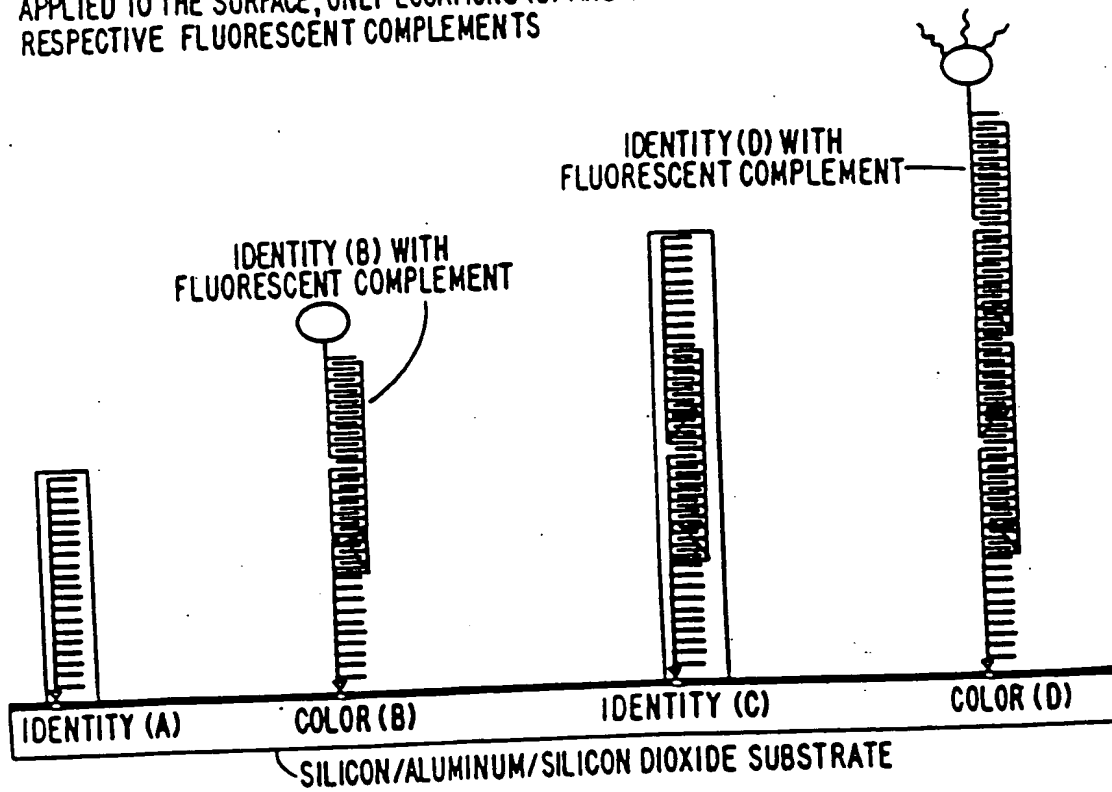




Fig. 23A

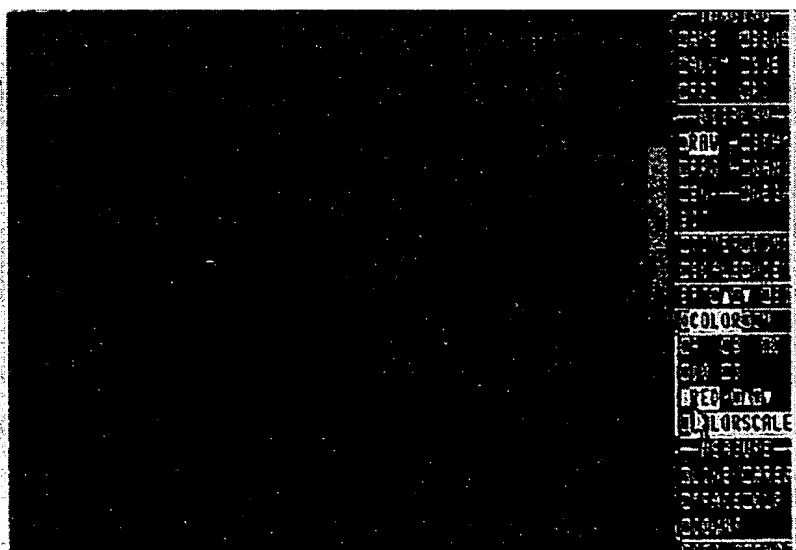


Fig. 23B

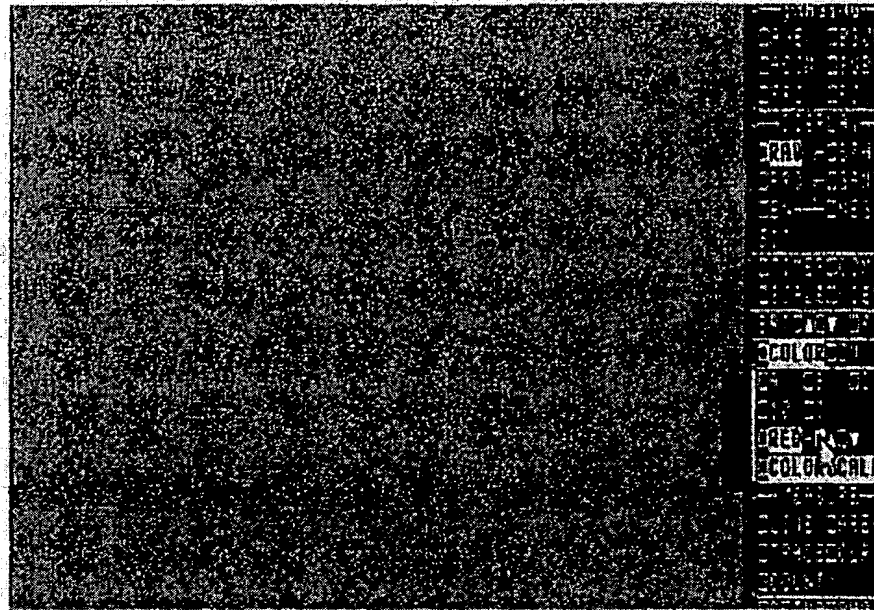
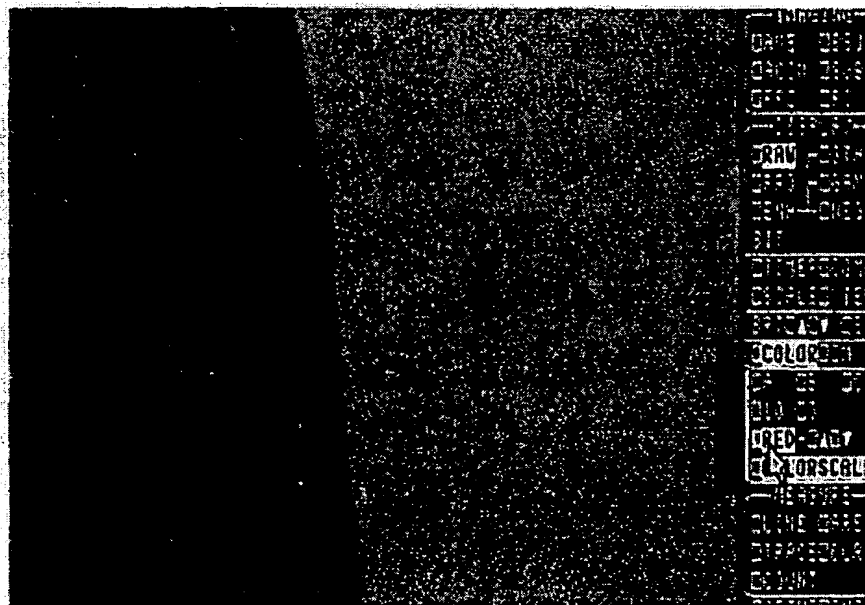


Fig. 24B



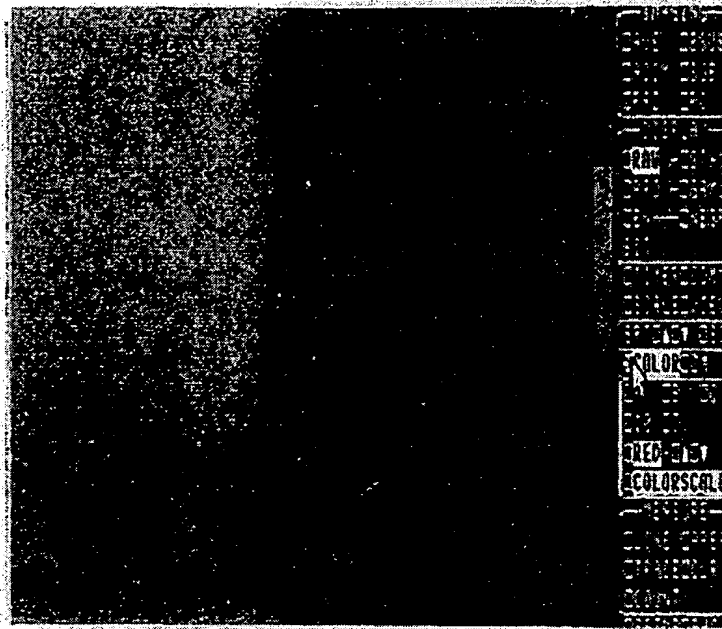


Fig. 25A

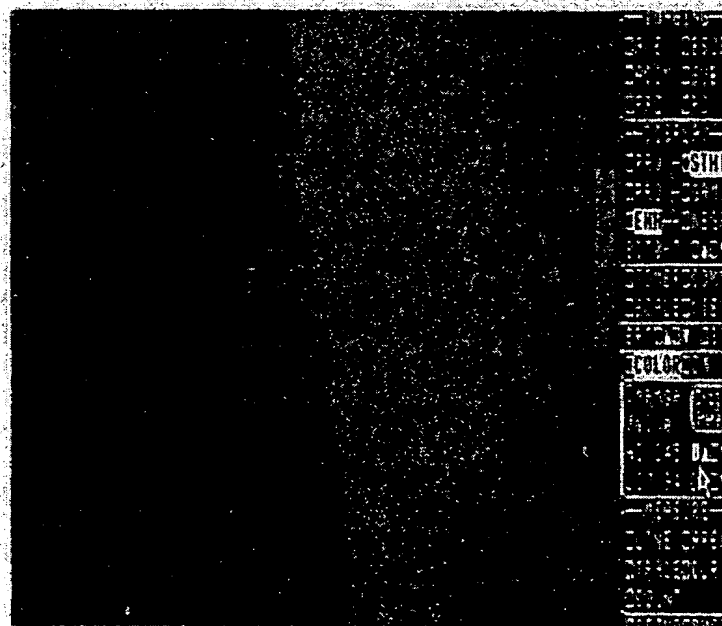


Fig. 25B

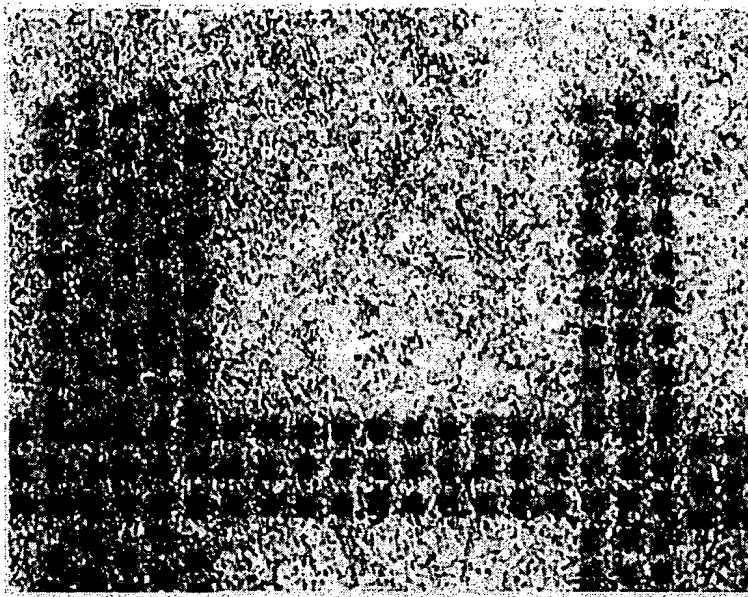


Fig. 26A

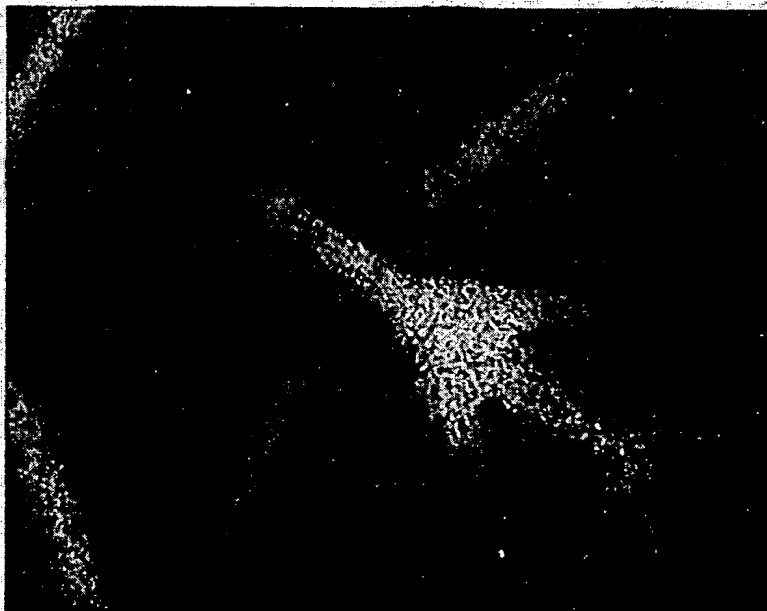


Fig. 26B

FIG. 27A

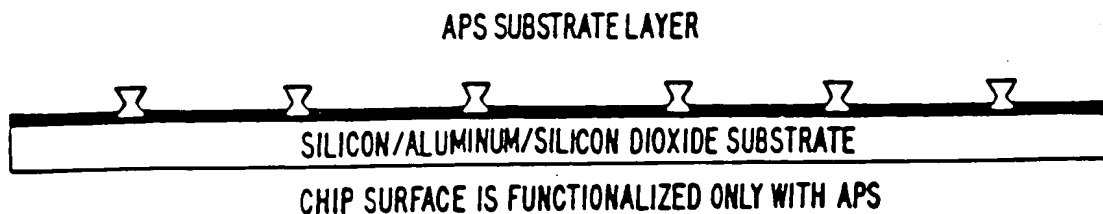


FIG. 27B

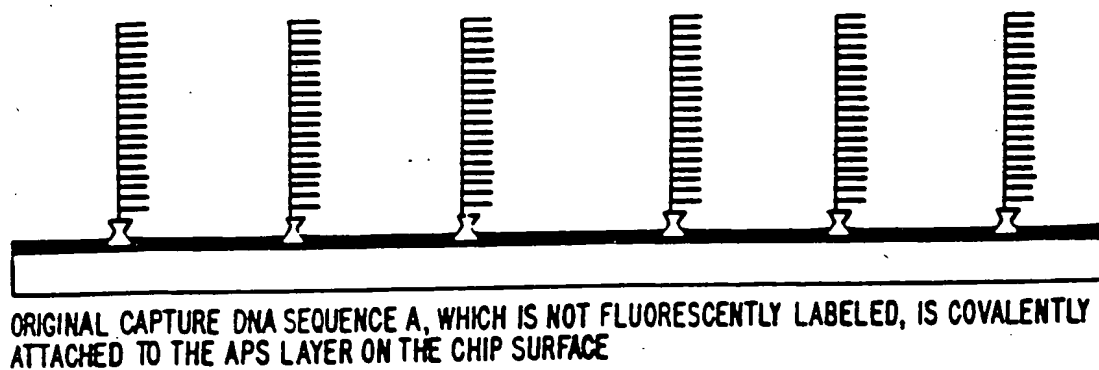


FIG. 27C

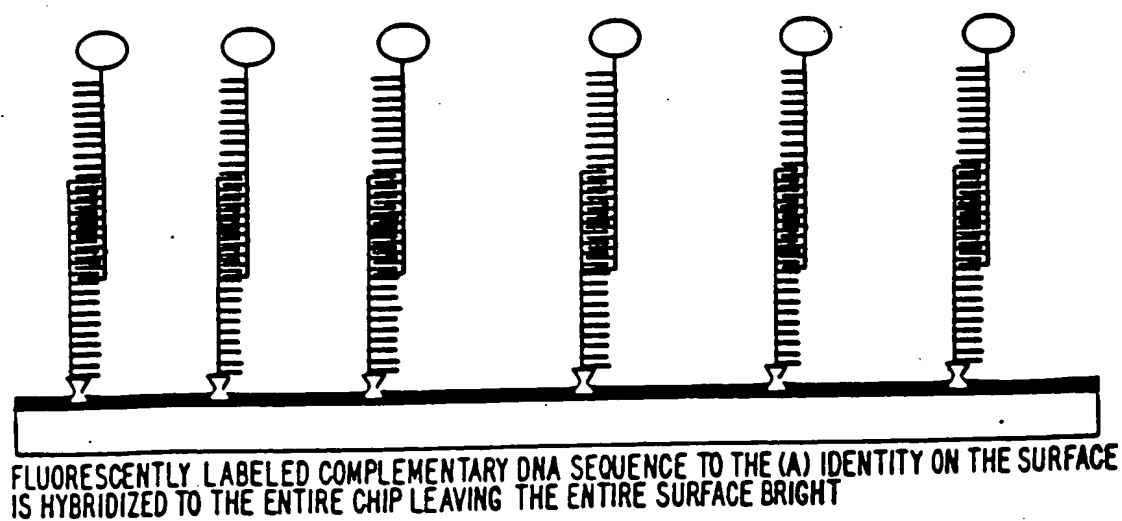
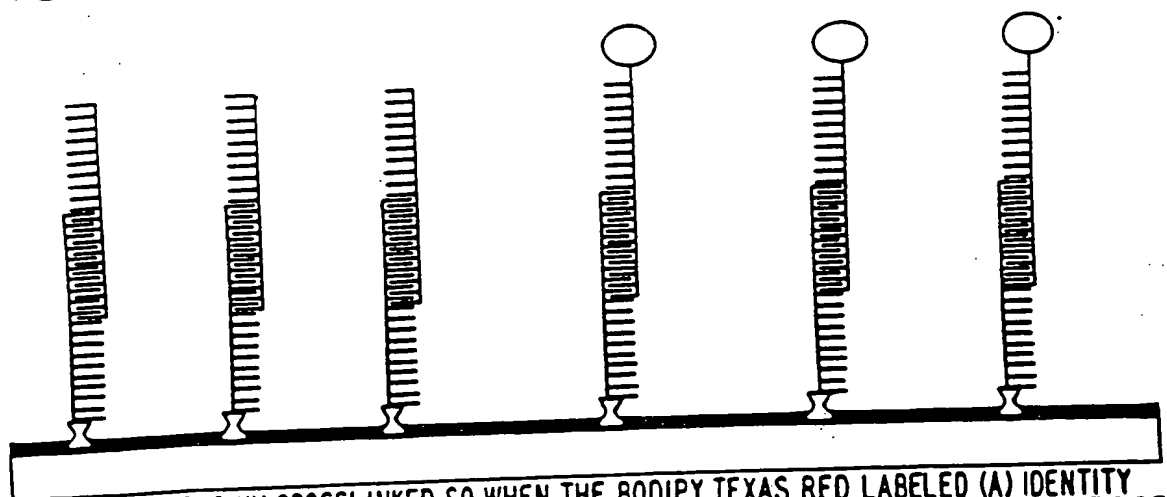
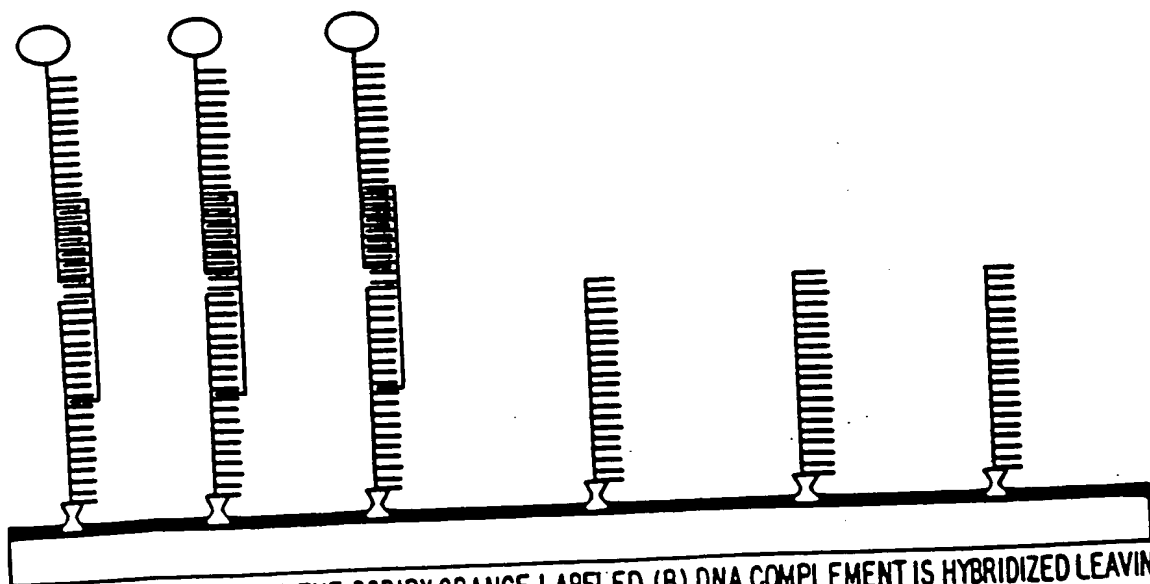


FIG. 28A



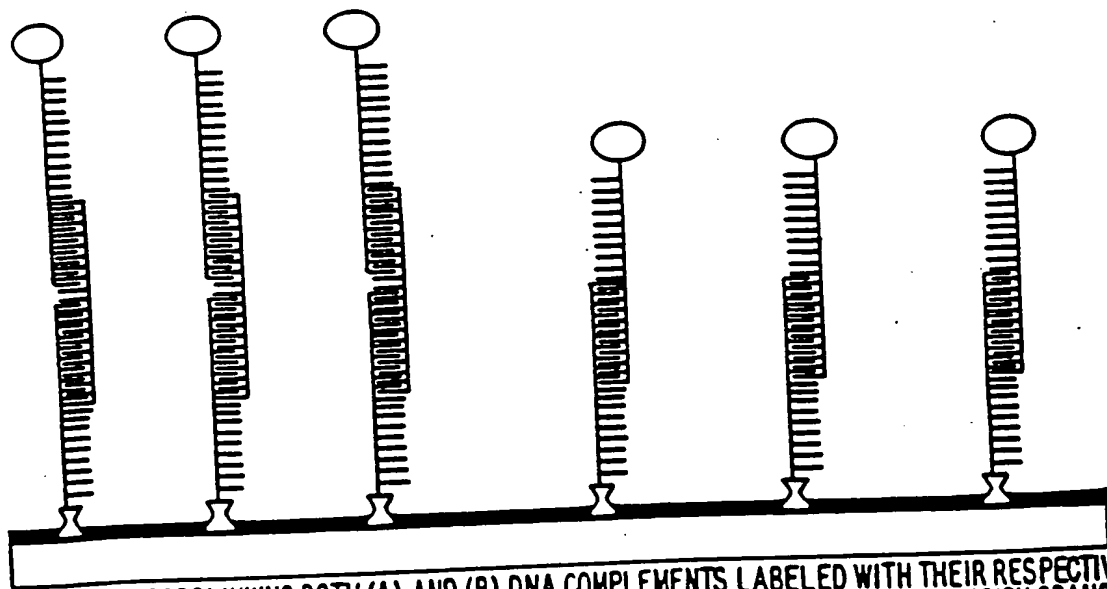
1/2 OF SURFACE IS UV CROSSLINKED SO WHEN THE BODIPY TEXAS RED LABELED (A) IDENTITY
COMPLEMENT IS HYBRIDIZED ACROSS THE ENTIRE CHIP ONLY THE NON-CROSSLINKED RIGHT SIDE
OF THE CHIP ATTAINS COLOR

FIG. 28B



AFTER UV CROSSLINKING THE BODIPY ORANGE LABELED (B) DNA COMPLEMENT IS HYBRIDIZED LEAVING
ONLY THE (B) IDENTITY LEFT SIDE OF THE CHIP BRIGHT

FIG. 28C



AFTER UV CROSSLINKING BOTH (A) AND (B) DNA COMPLEMENTS LABELED WITH THEIR RESPECTIVE FLUOROPHORES ARE HYBRIDIZED TO THE SURFACE, THE LEFT SIDE ATTAINING THE BODIPY ORANGE AND THE RIGHT ATTAINING THE BODIPY TEXAS RED COLOR

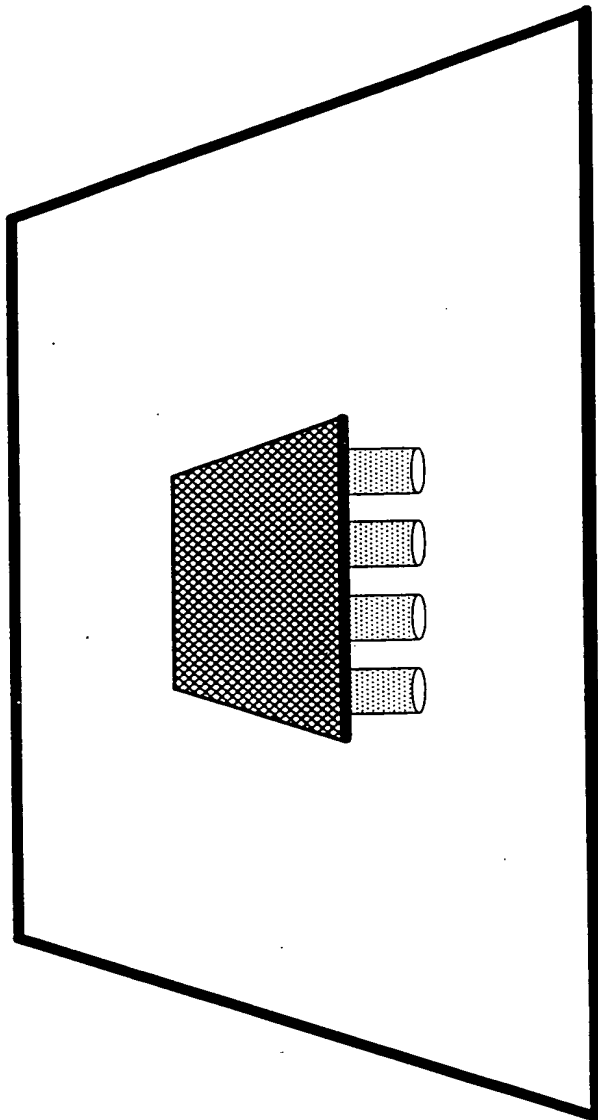


FIG. 29

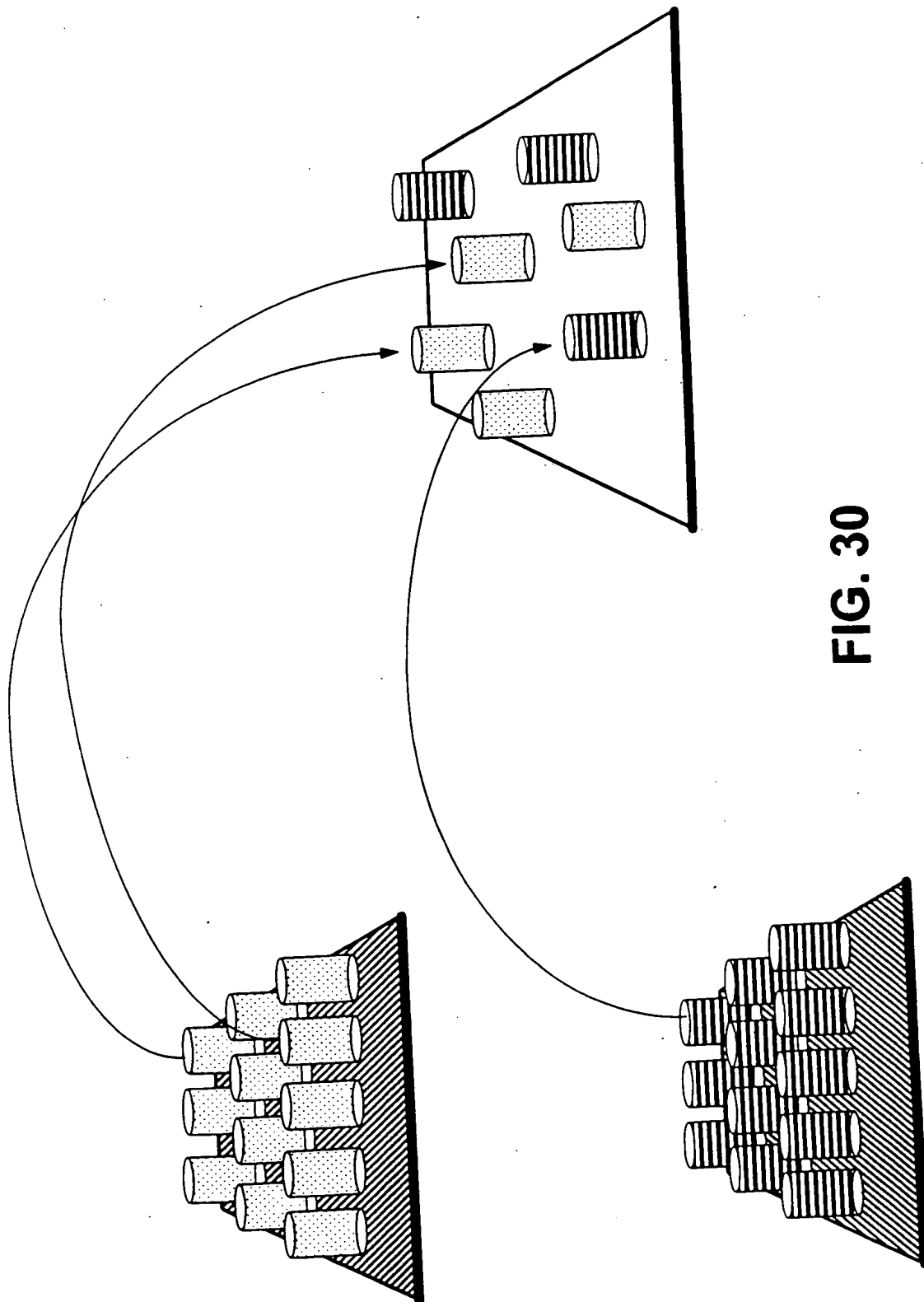


FIG. 30

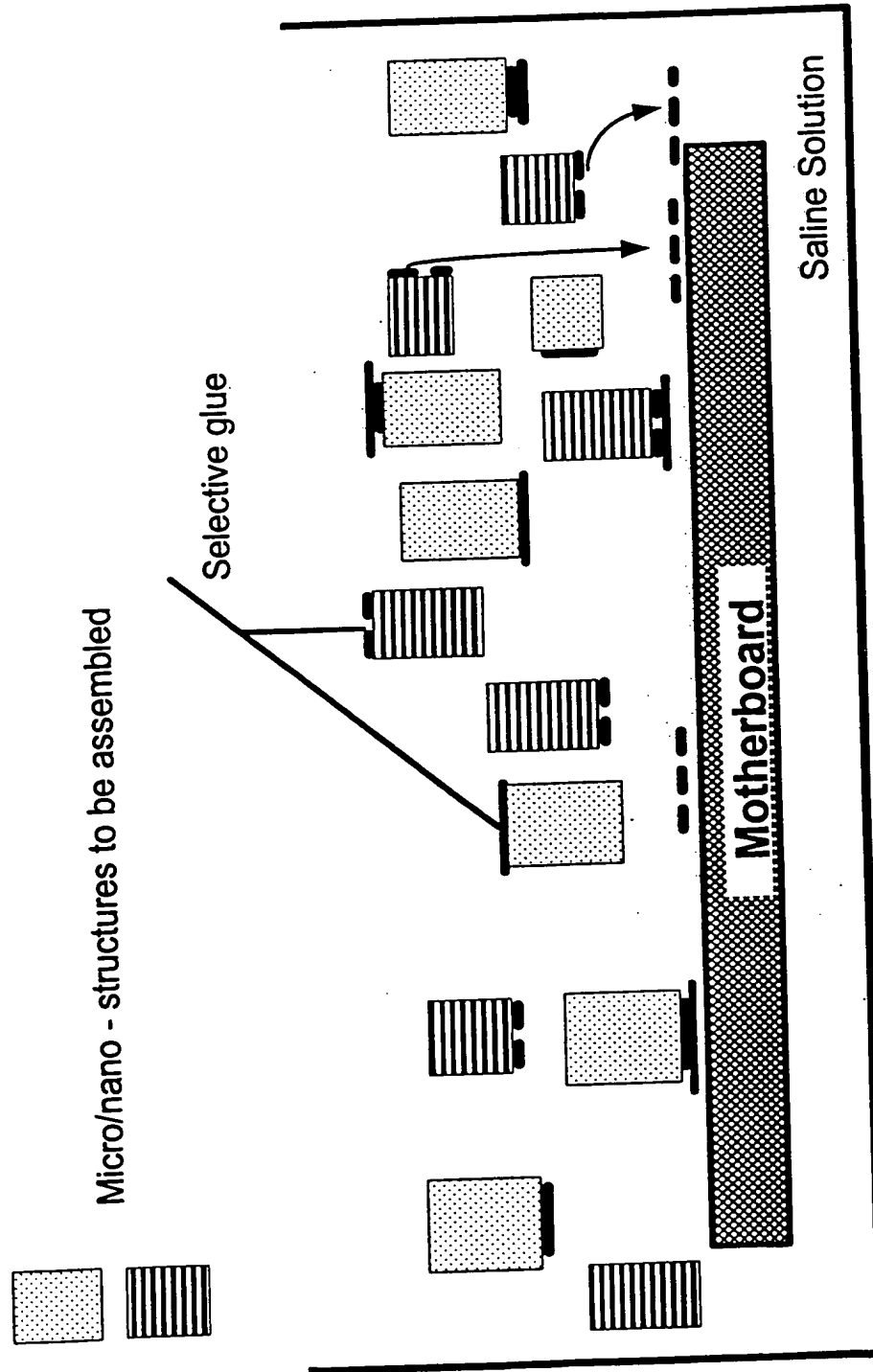


FIG. 31

ELECTRODES

FIG. 32

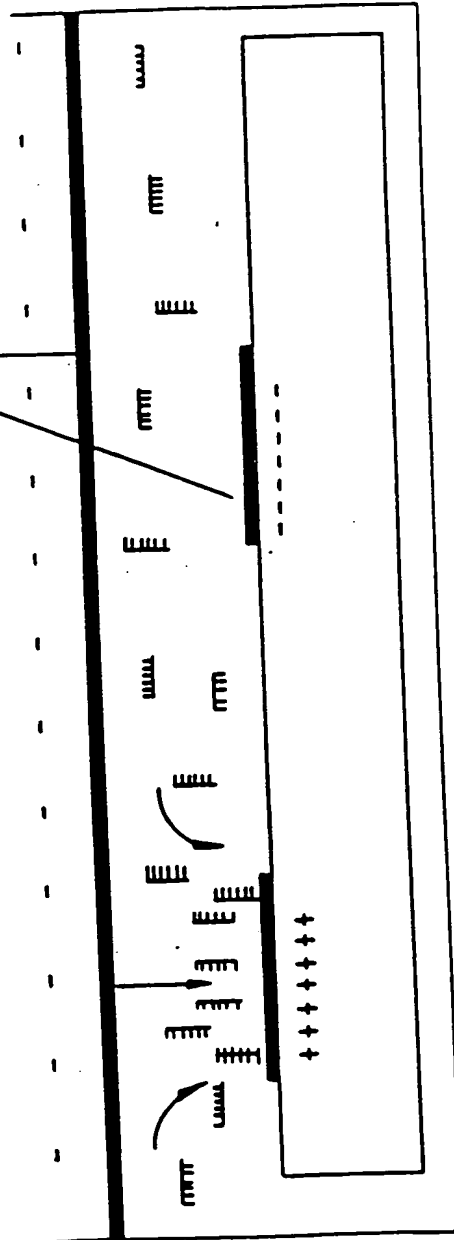


FIG. 33

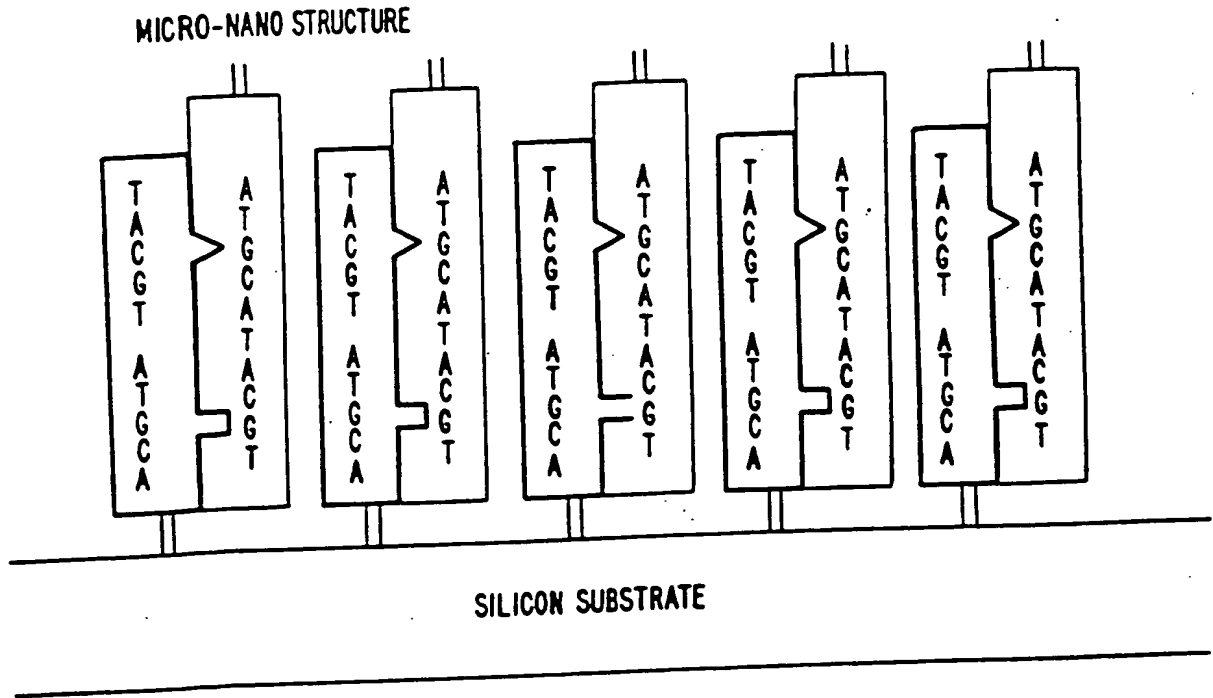


FIG. 34

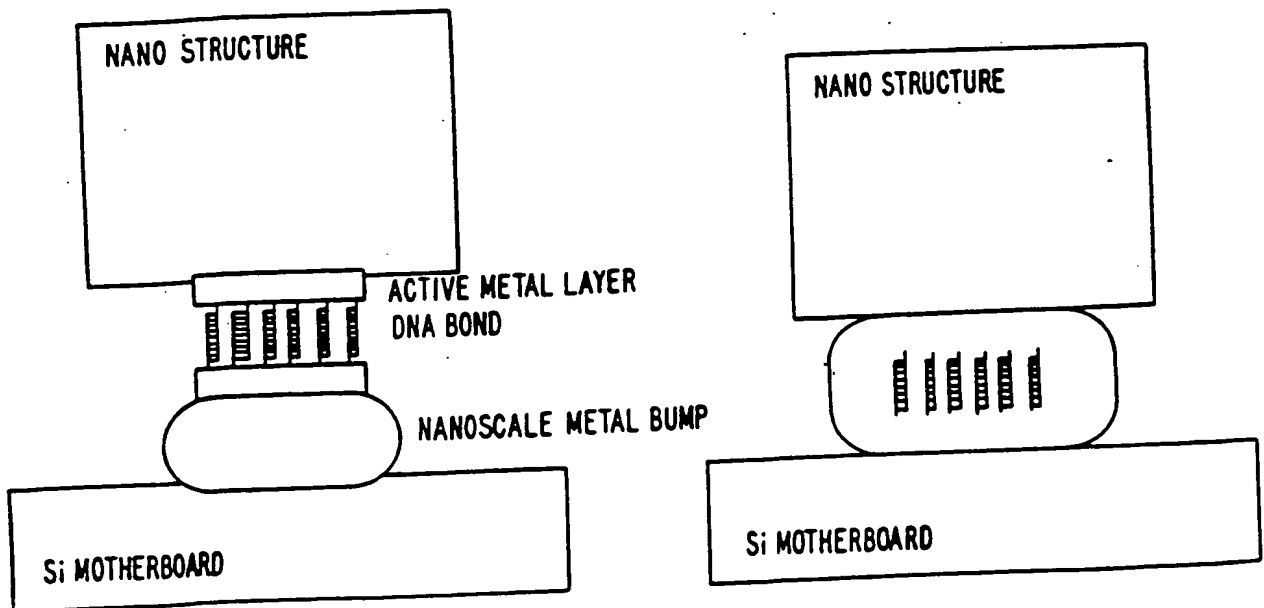
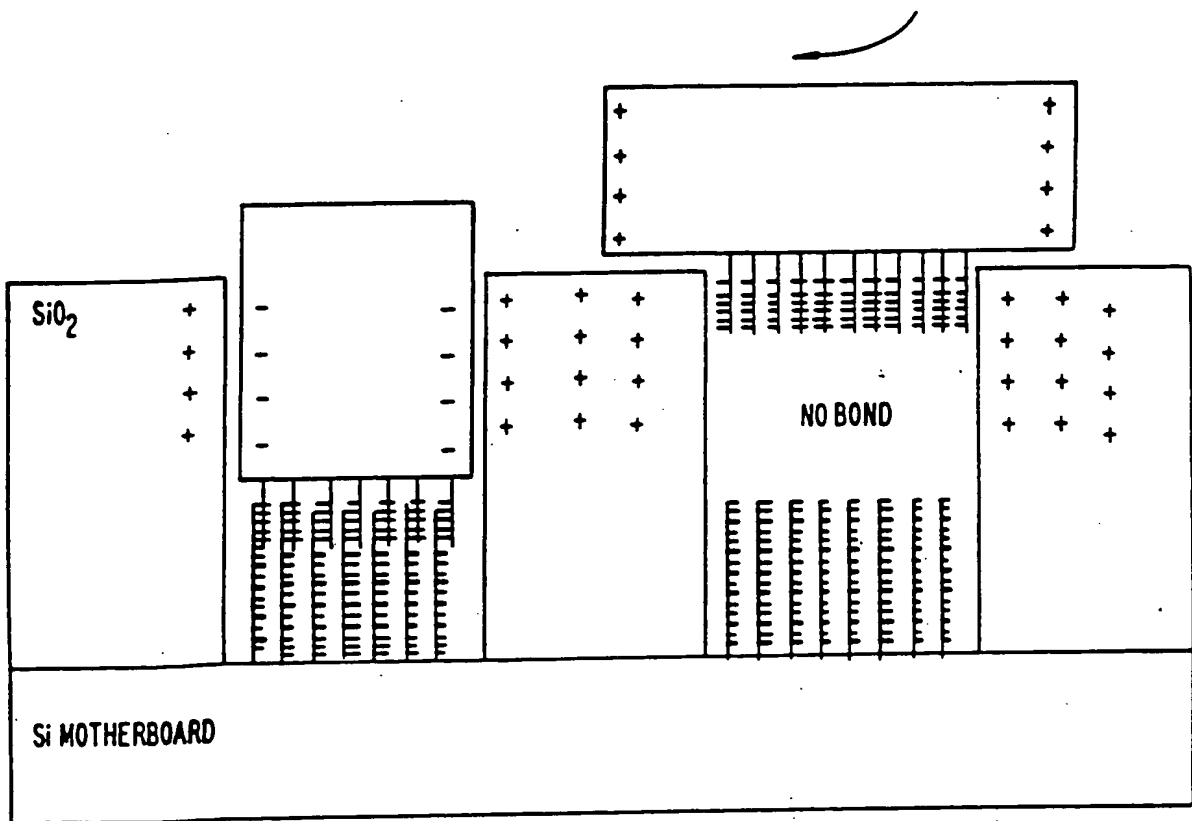
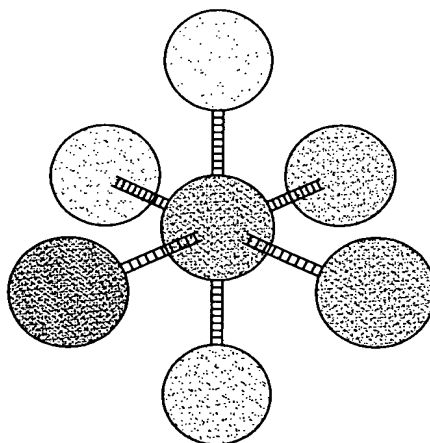
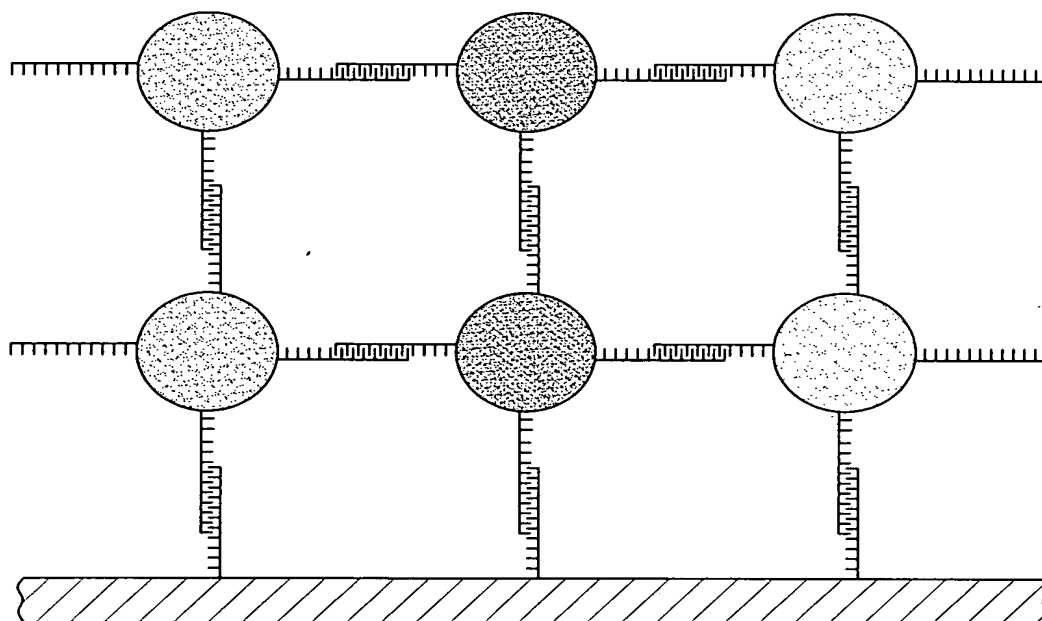


FIG. 35





NANOSPHERES ARRANGED IN OCTAHEDRON
USING 3D DNA NANOCONSTRUCTION TECHNIQUES



NANOSPHERES ARRANGED INTO LATTICE STRUCTURE AND BOUND TO SURFACE TO CREATE A 3D DEVICE

FIG. 36

FIG. 37

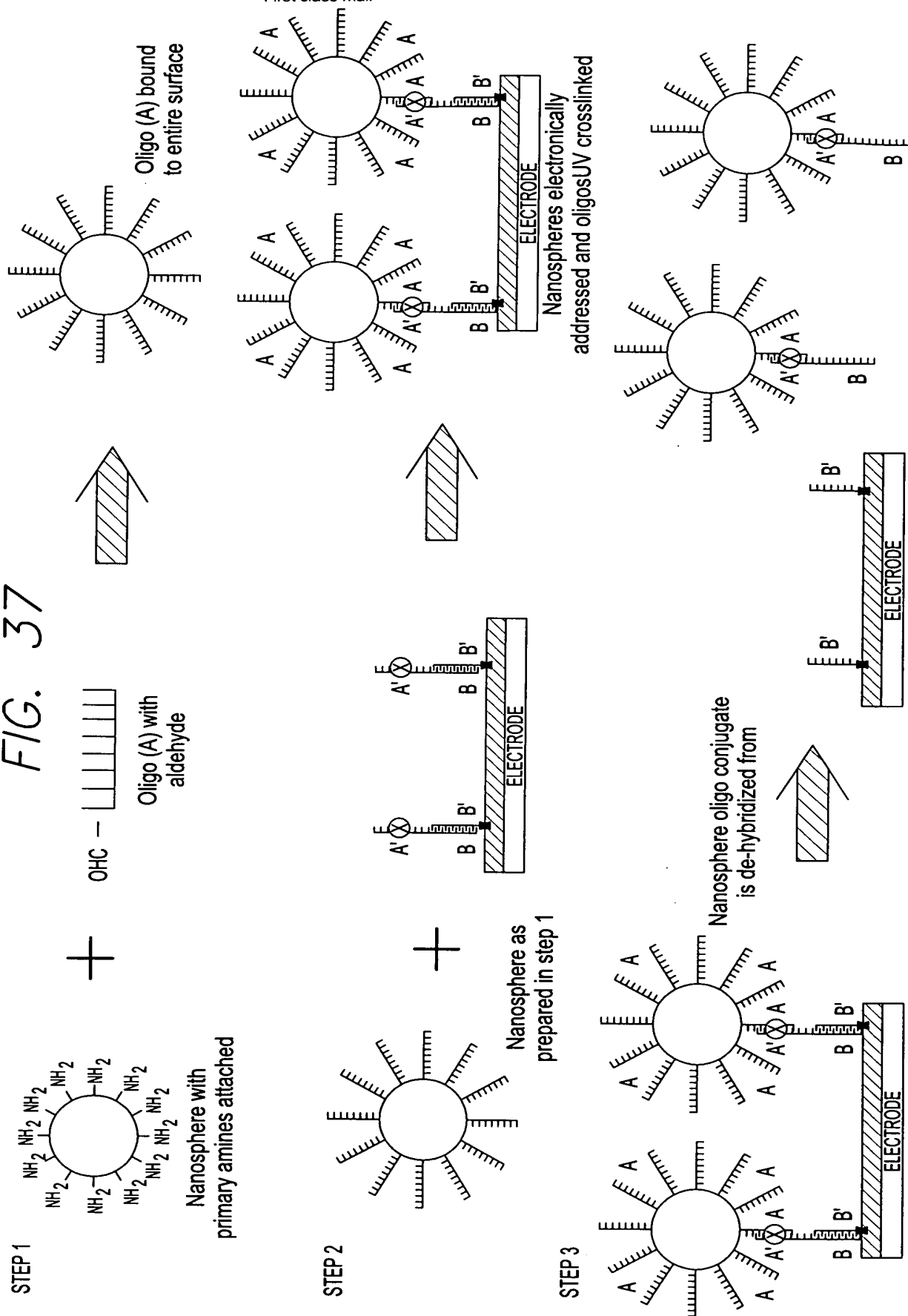
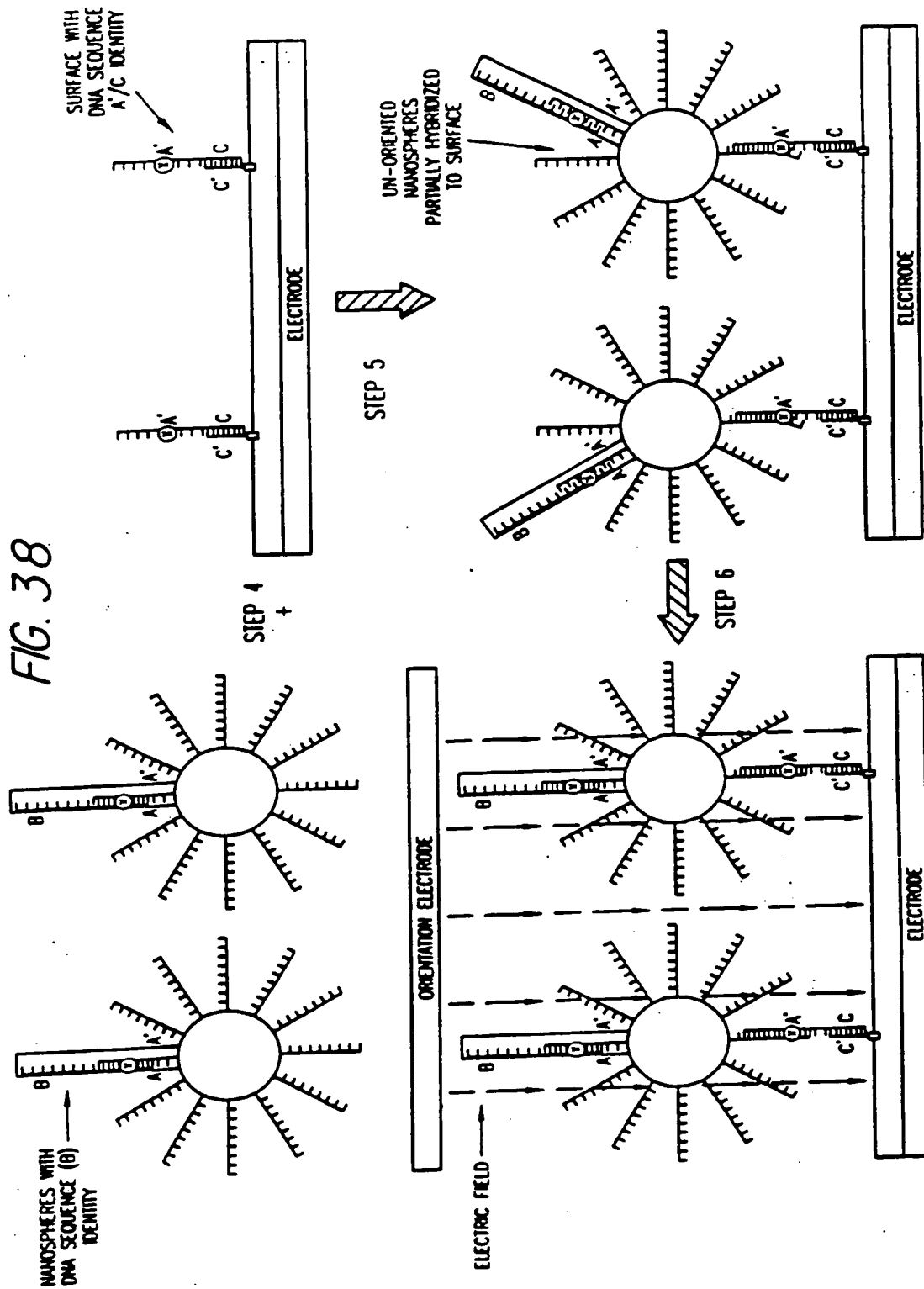


FIG. 38



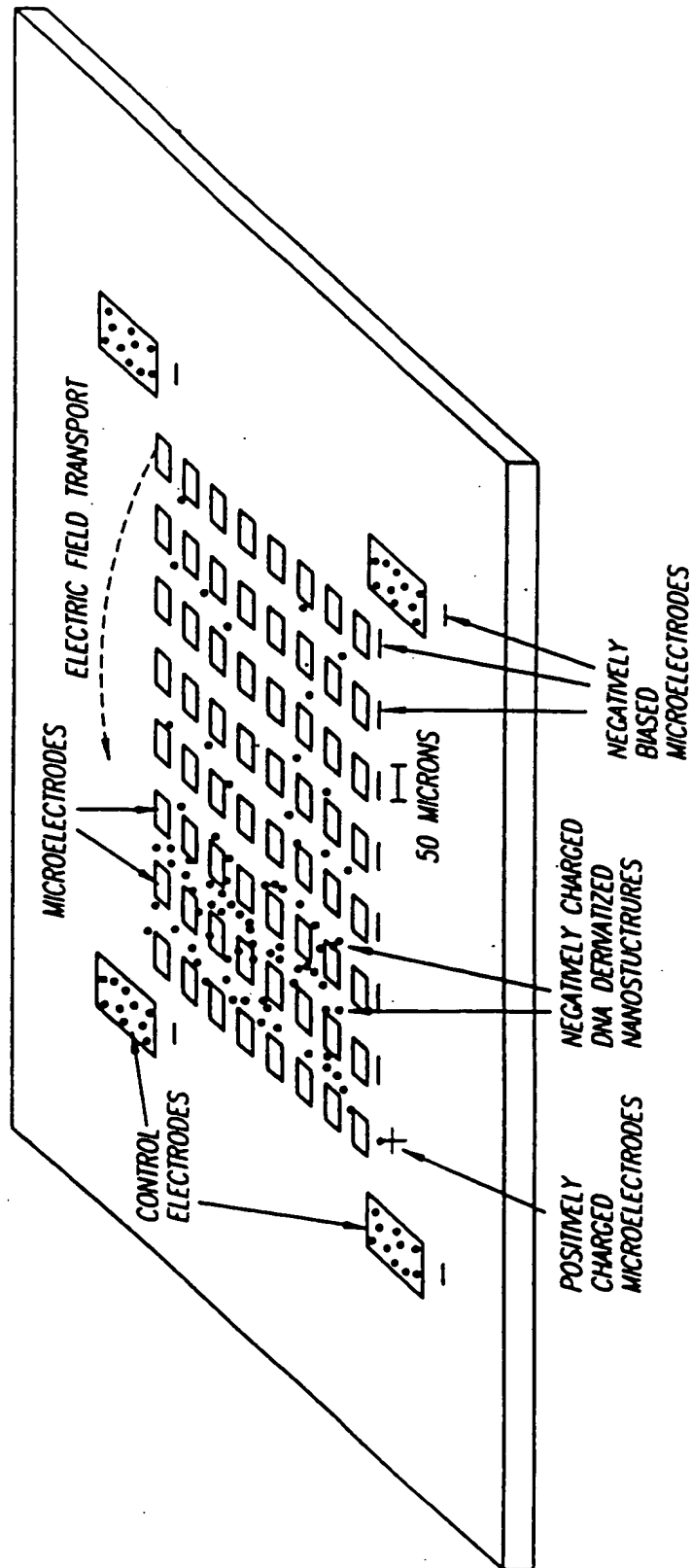


FIG. 39

NEGATIVELY CHARGED TYPE 1 NANOSTRUCTURES
MOVE TOWARD POSITIVELY BIASED MICROLOCATION

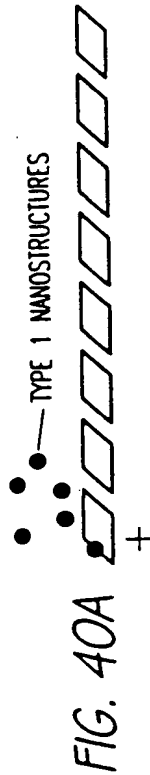


FIG. 40A

TYPE 1 NANOSTRUCTURES ACCUMULATE
ON THE POSITIVELY BIASED MICROLOCATION



FIG. 40B

NEGATIVELY CHARGED TYPE 2 NANOSTRUCTURES ARE
INTRODUCED OVER THE ARRAY AND ACCUMULATE
ON THE POSITIVELY BIASED MICROLOCATIONS

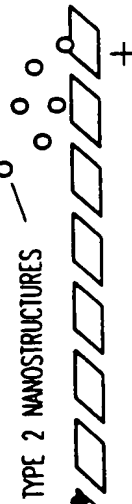


FIG. 40C

BOTH TYPE 1 AND TYPE 2 NANOSTRUCTURES ARE NOW
CLUSTERED ONTO THEIR RESPECTIVE MICROLOCATIONS



FIG. 40D

ELECTRONICALLY ASSISTED SELF-ASSEMBLY BEGINS WHEN
MICROLOCATION #1 IS BIASED NEGATIVE AND A CENTER
MICROLOCATION IS BIASED POSITIVE CAUSING THE NEGATIVELY
CHARGED TYPE 1 NANOSTRUCTURES TO MOVE TO CENTER LOCATION

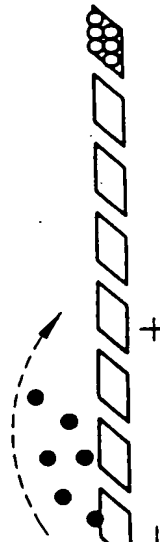


FIG. 40E

TYPE 1 NANOSTRUCTURES ACCUMULATE AND
HYBRIDIZE TO THE SPECIFIC MICROLOCATION



FIG. 40F

TYPE 2 NANOSTRUCTURES ARE MOVED TO CENTER
LOCATION BY BIASING MICROLOCATION #8
NEGATIVE AND CENTER LOCATION POSITIVE

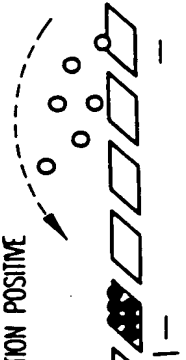


FIG. 40G

TYPE 2 NANOSTRUCTURES CONTAINING COMPLEMENTARY
DNA SEQUENCE HYBRIDIZE TO TYPE 1 NANOSTRUCTURES



FIG. 40H

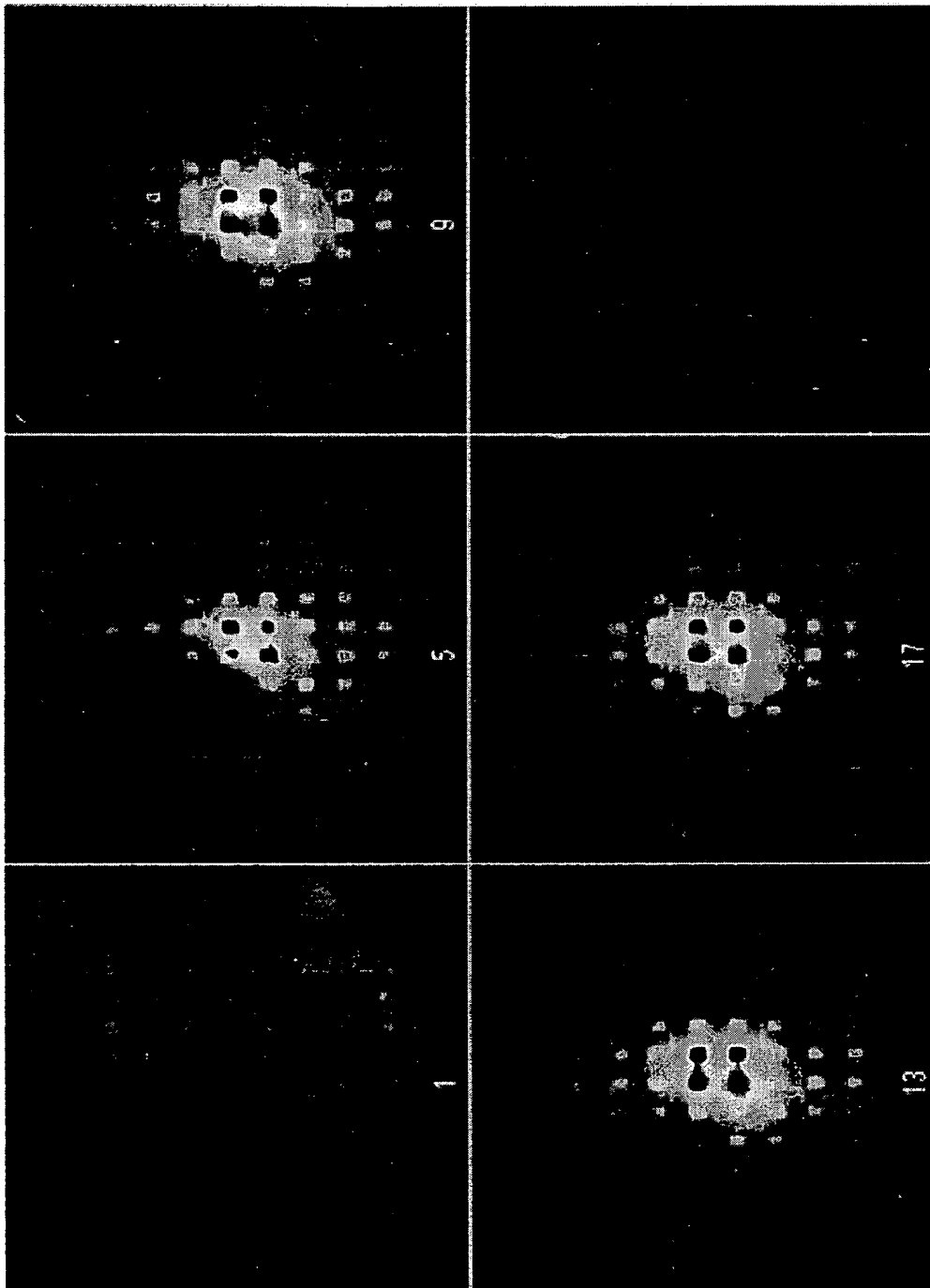
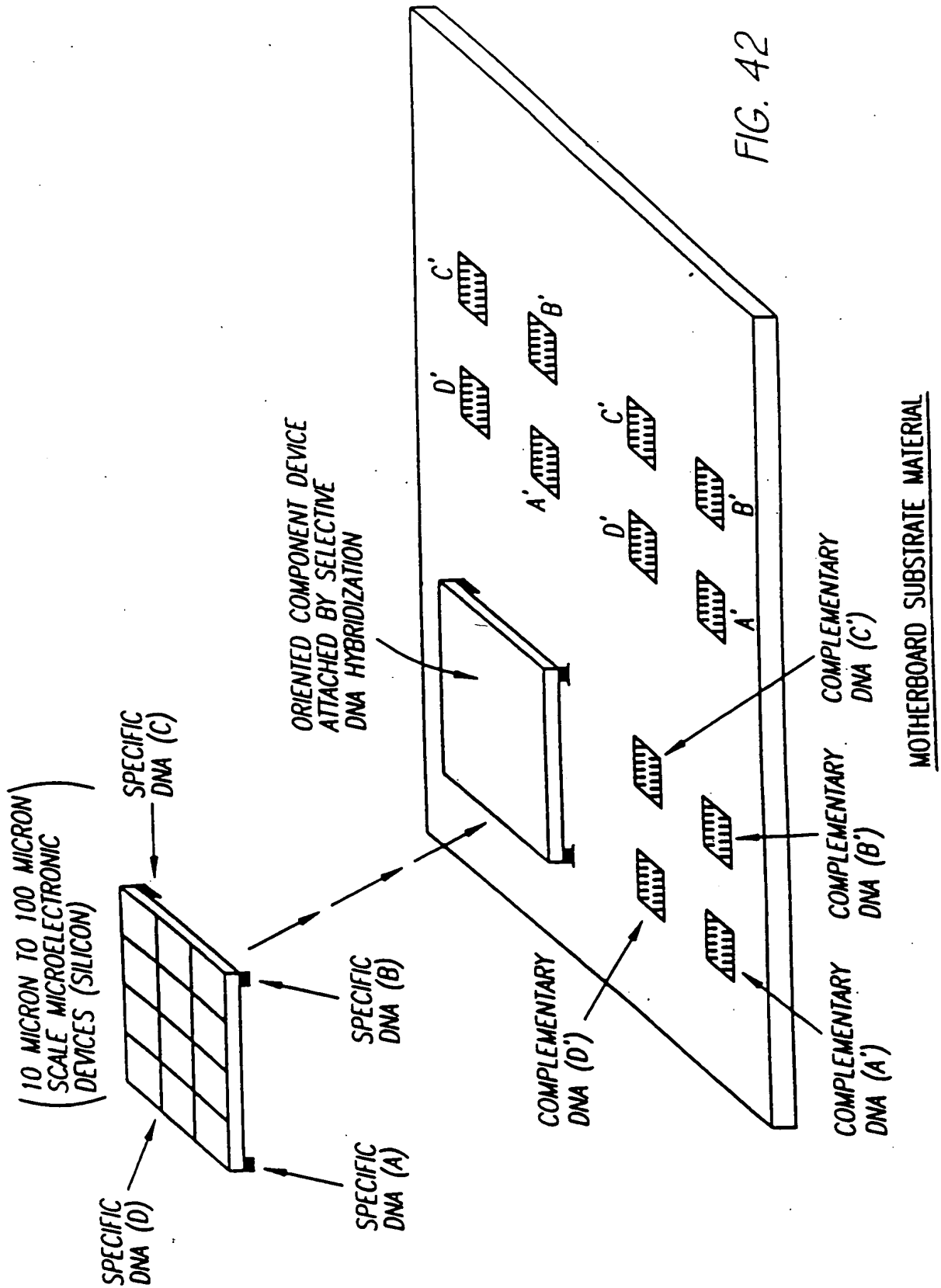


Fig. 41



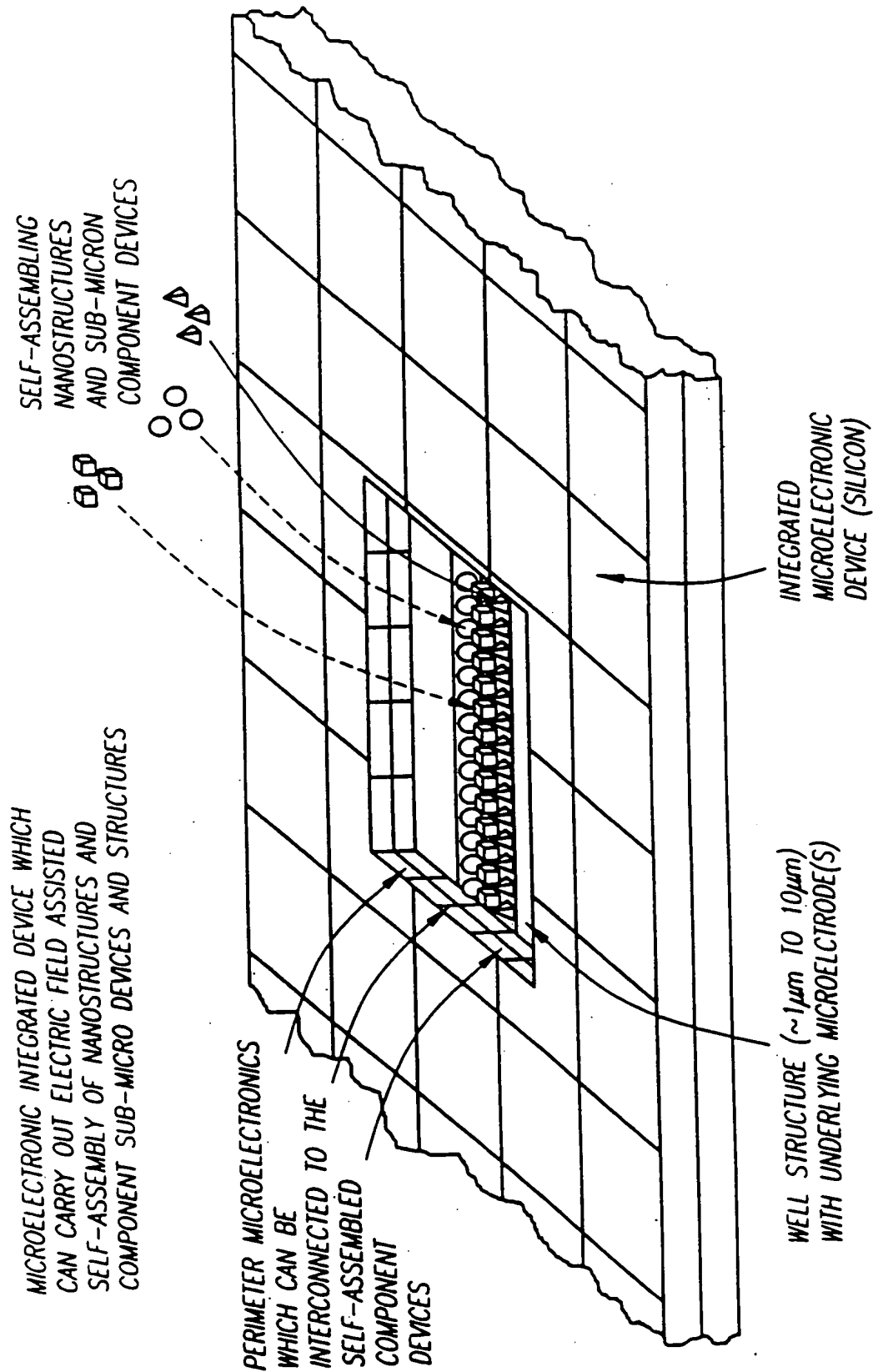


FIG. 43

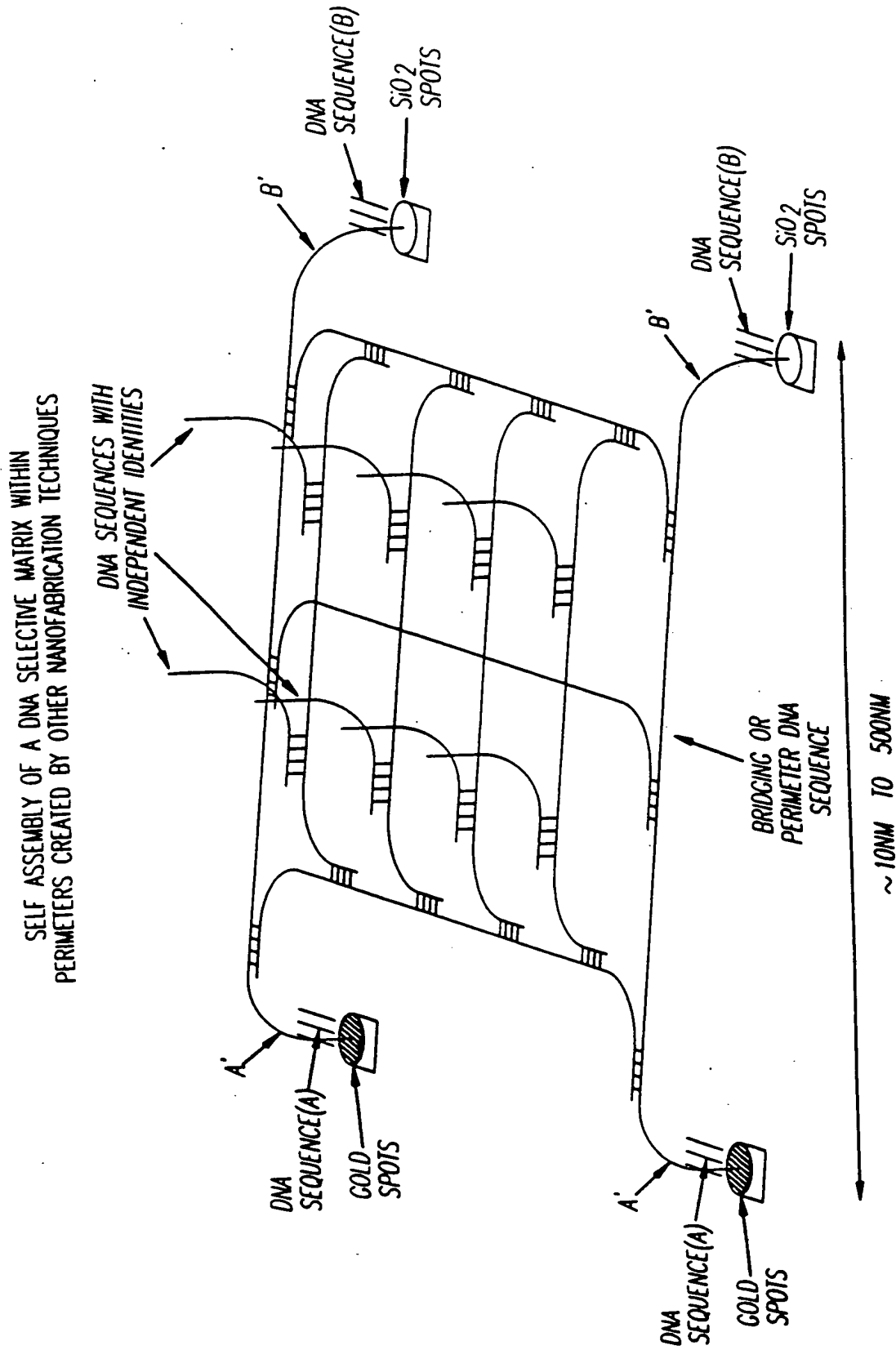


FIG. 44

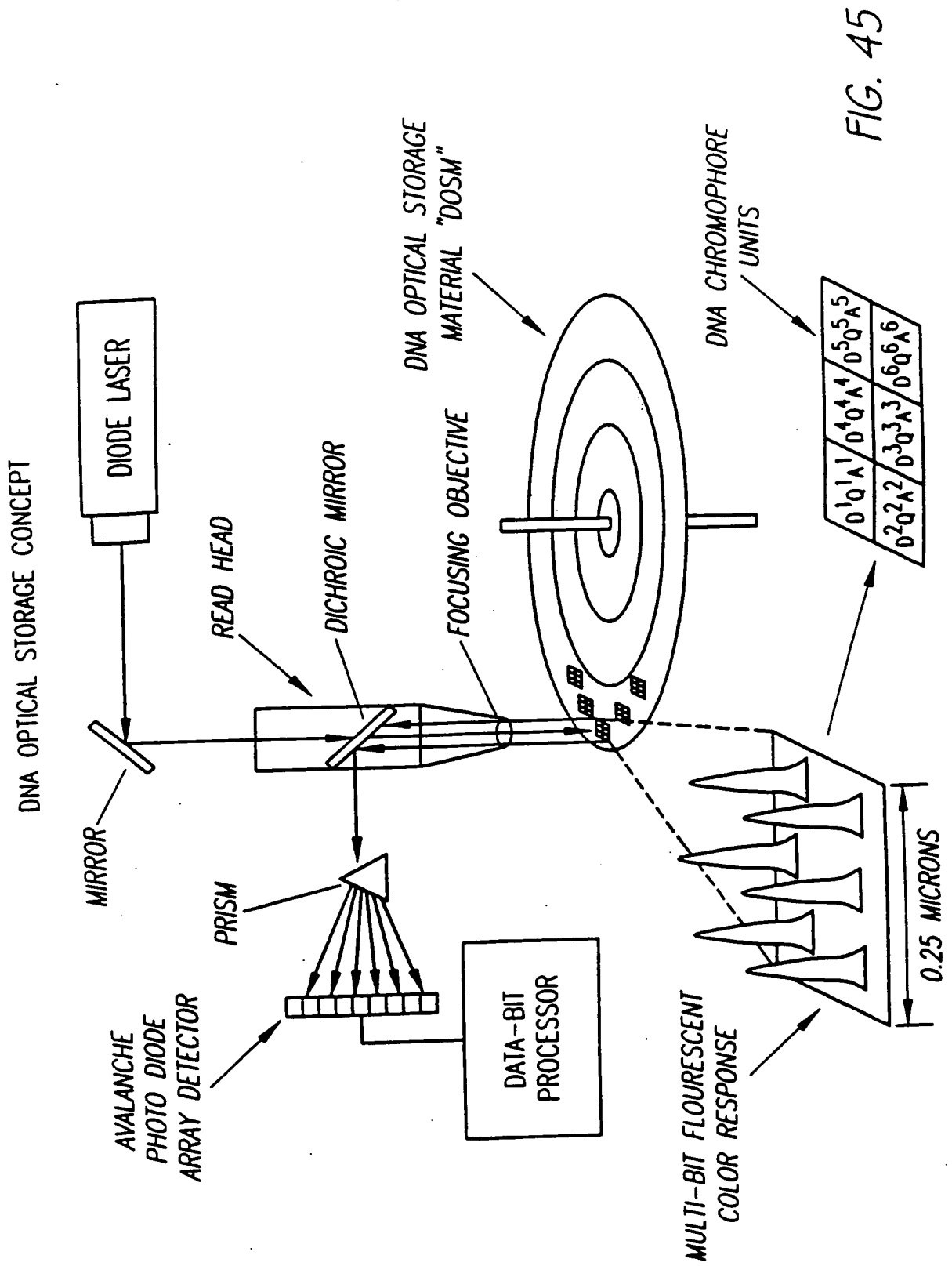


FIG. 45

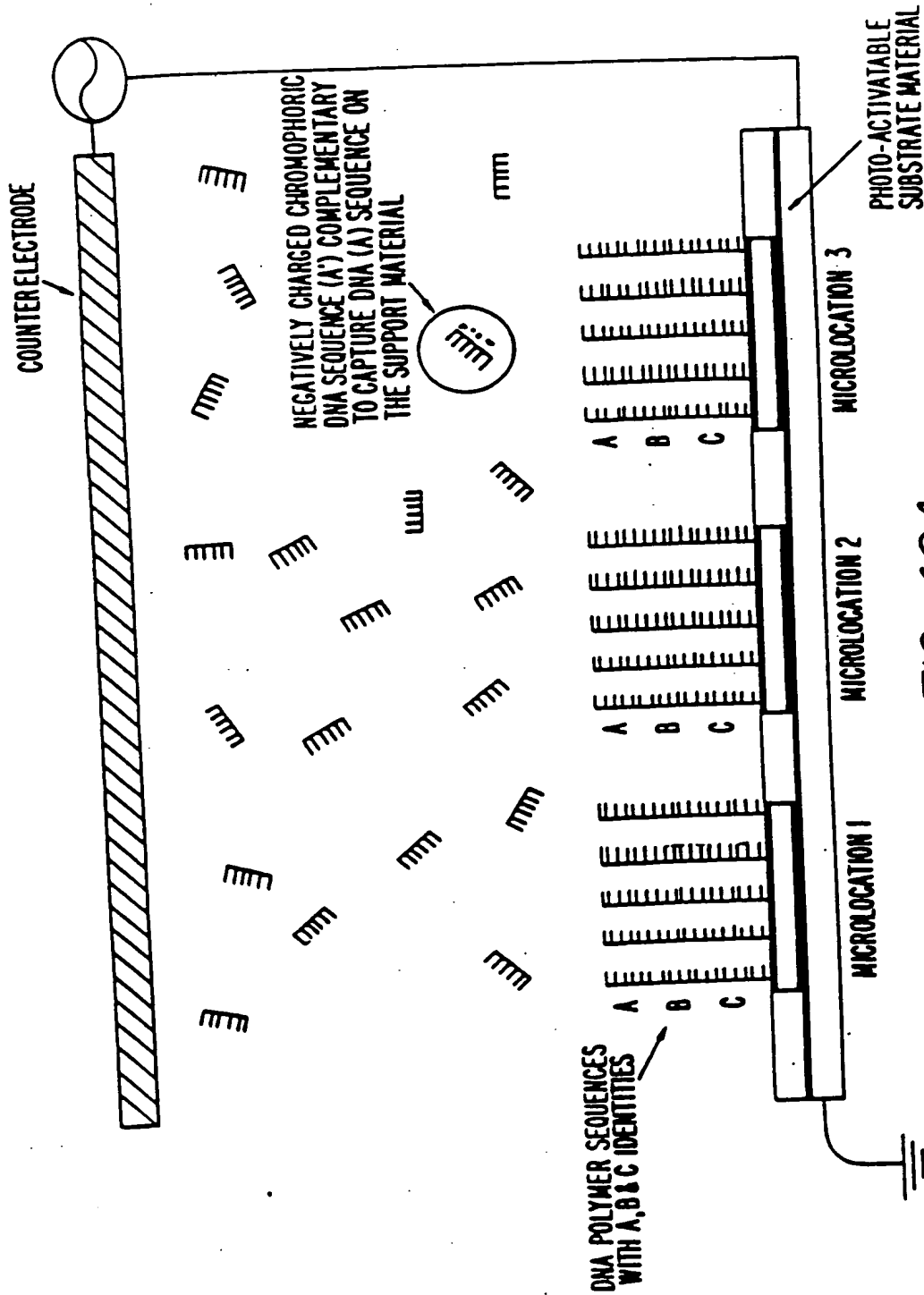
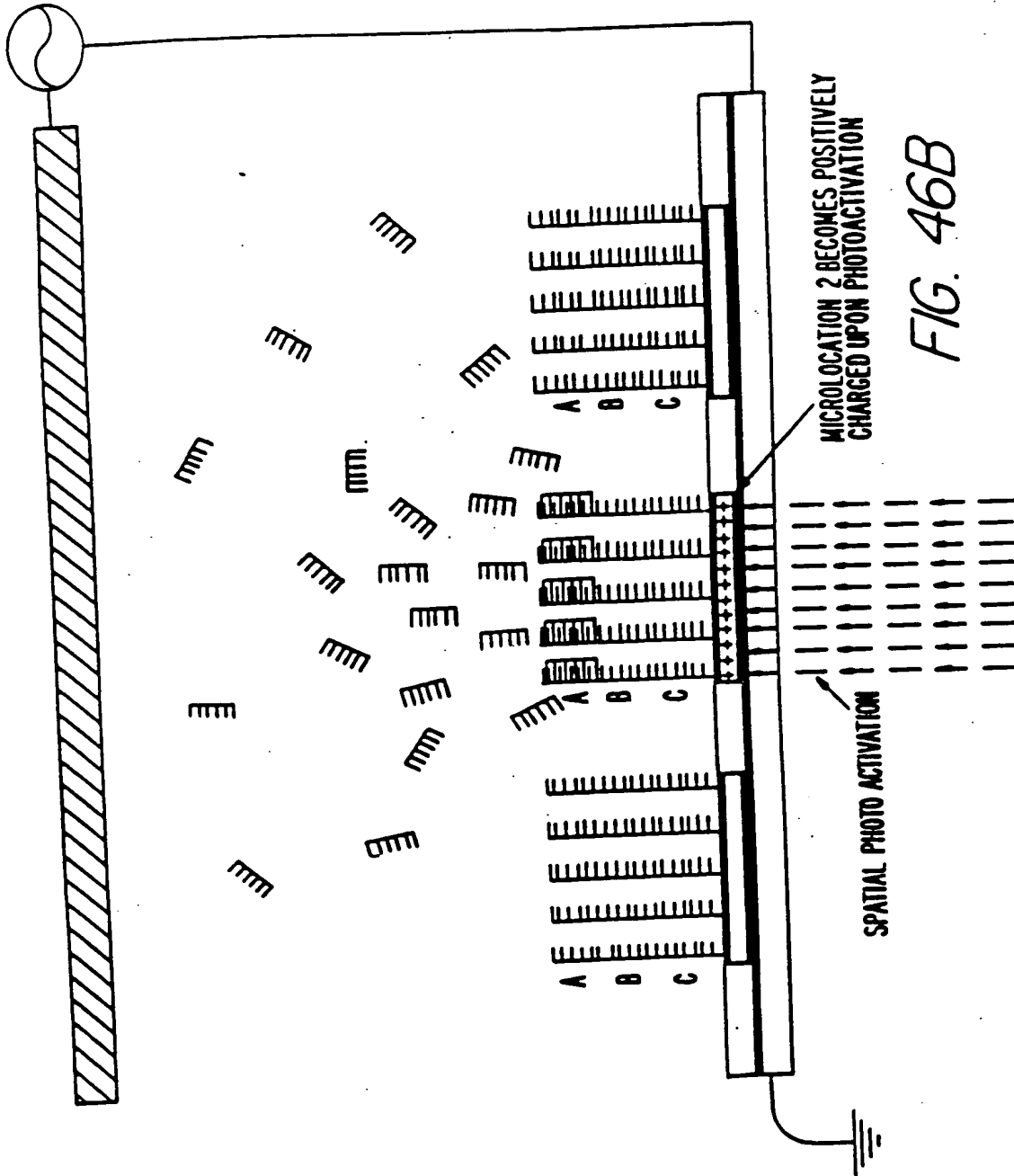
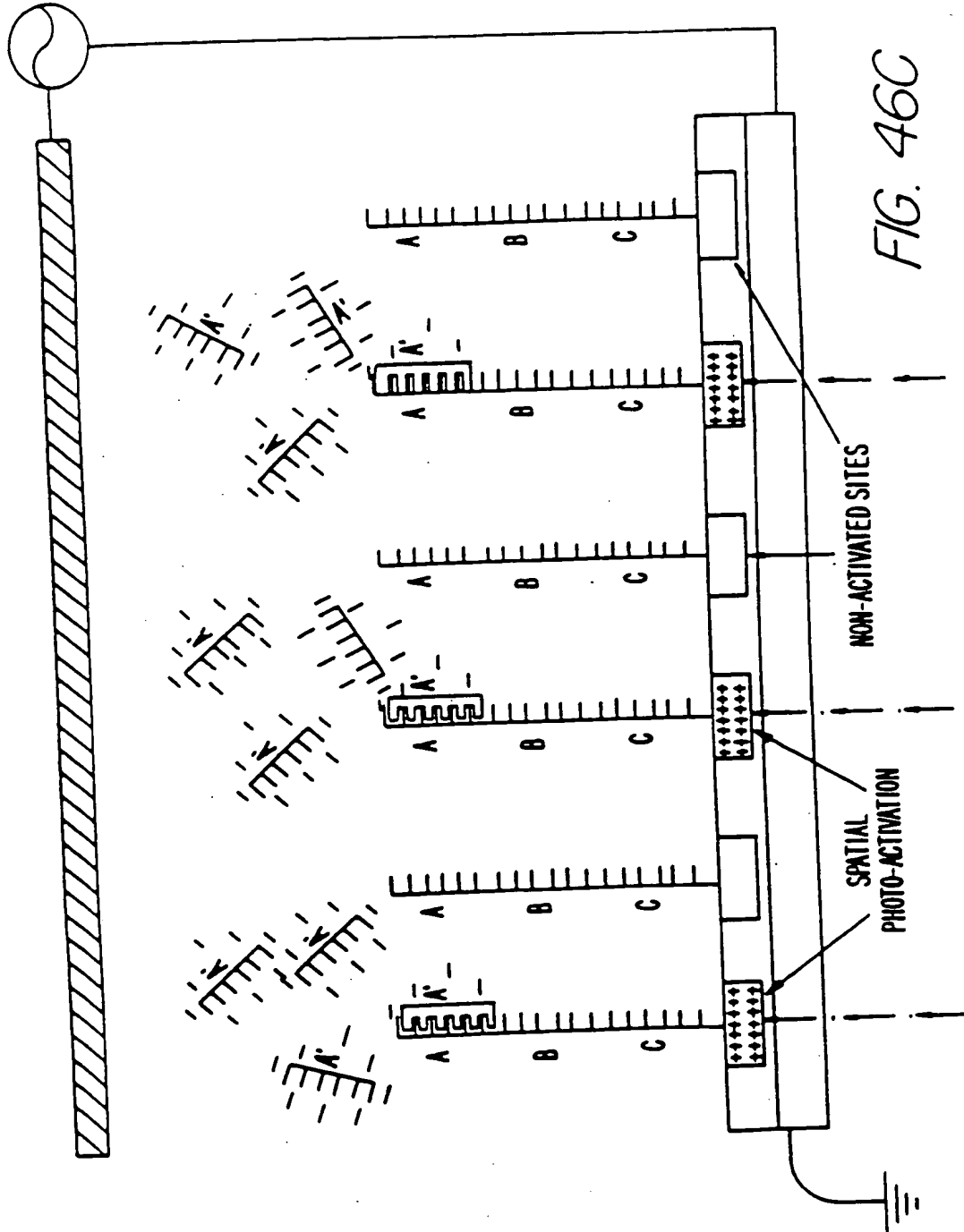


FIG. 46A





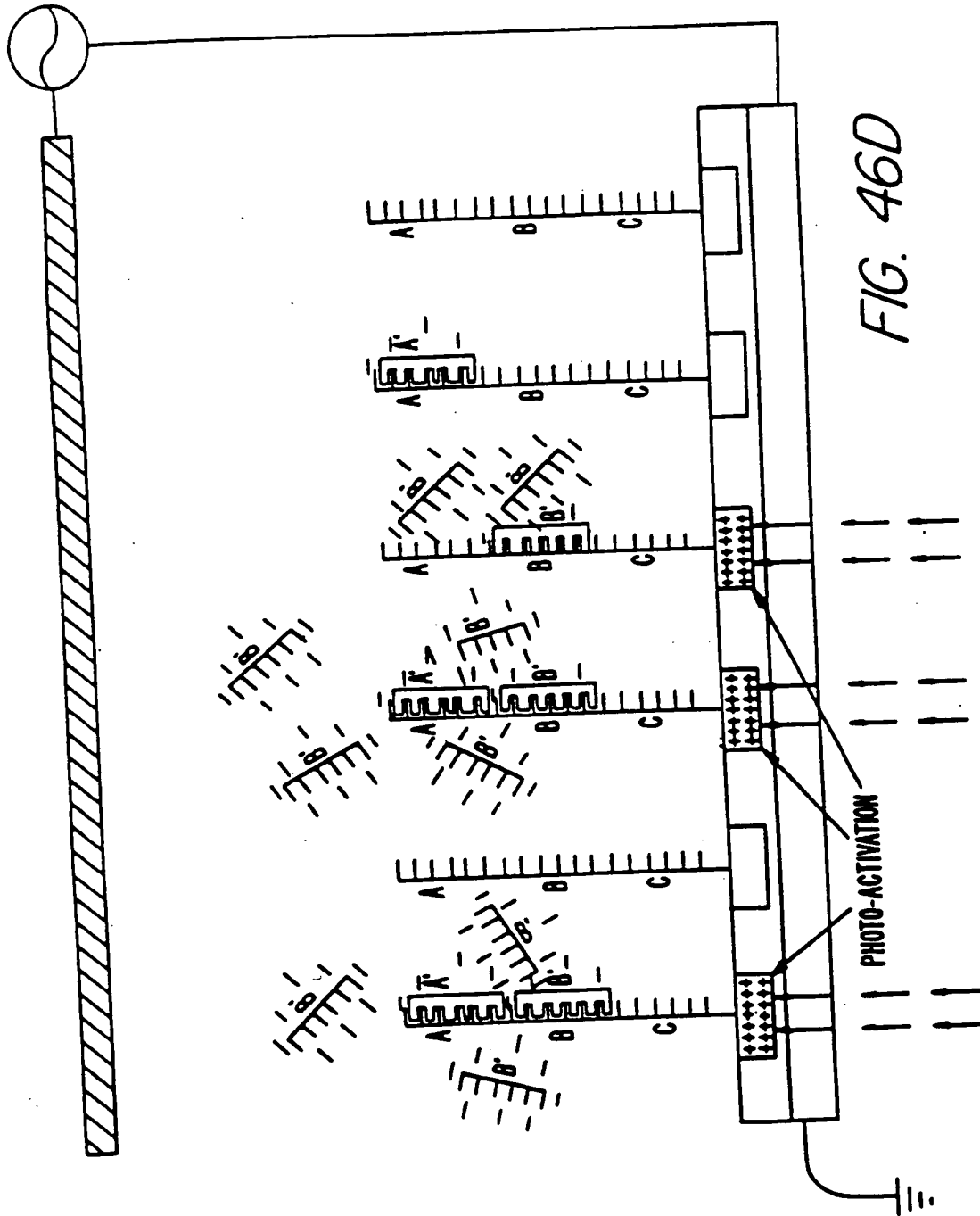


FIG. 46E

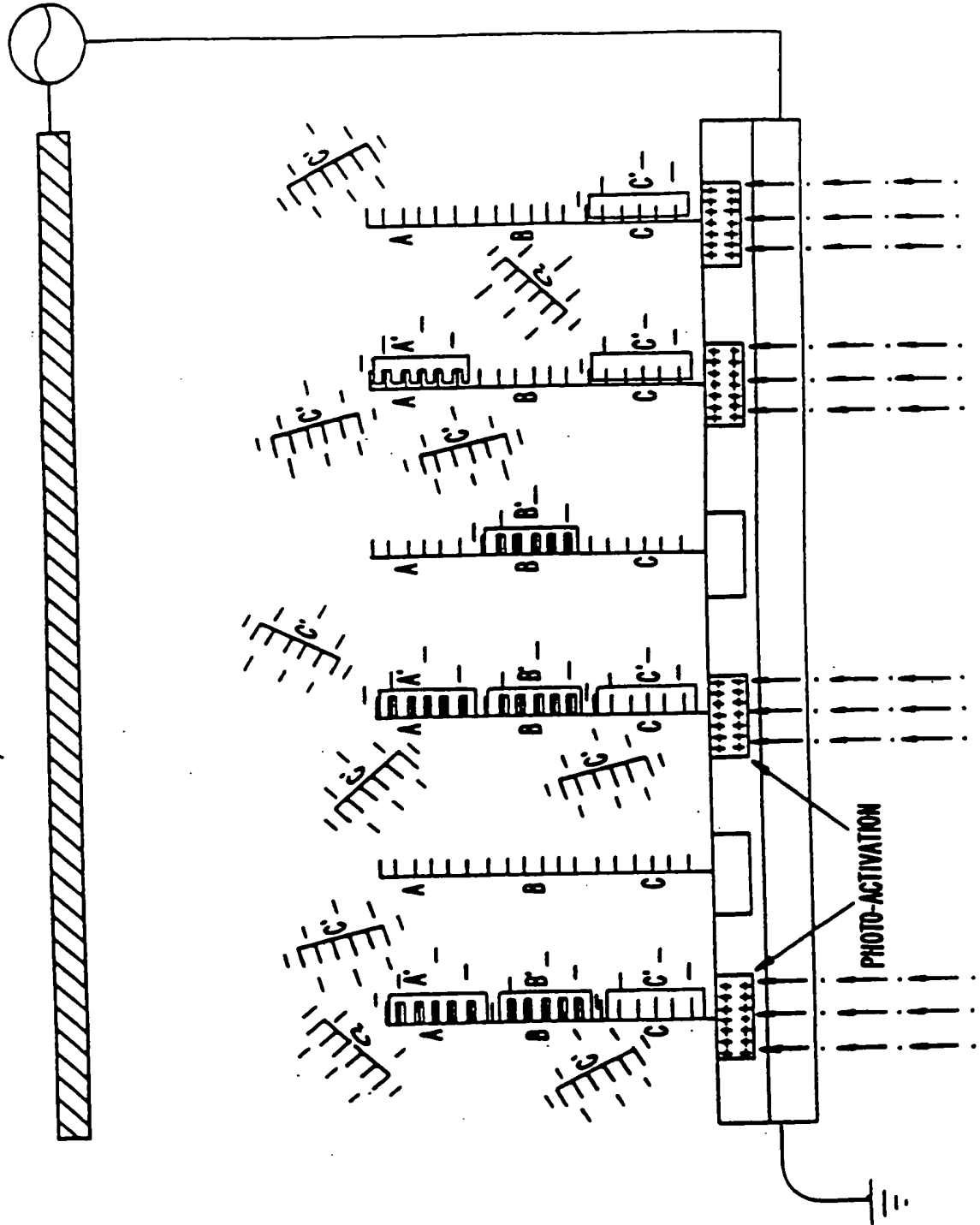


FIG. 46F

SPATIAL LIGHT ADDRESSING PROCESS COMPLETE

